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The views expressed in this presentation are those of the author(s) and do not necessarily reflect the official policy or position of the US Naval War College, the Department of the Navy, the Department of Defense, nor the US Government."



# "The Battlespace Environment"

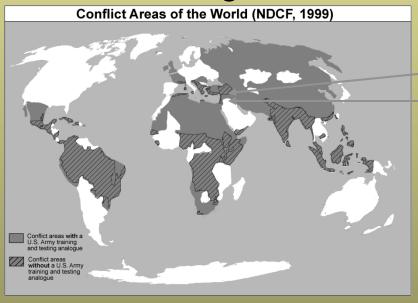
...to the Army or Marine infantryman this means:

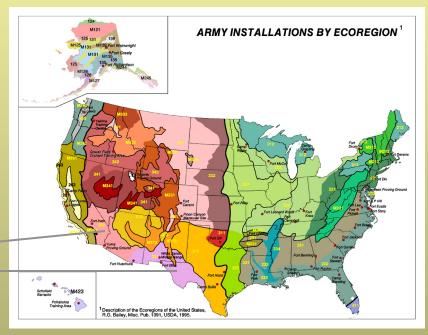


- ☐ The "terrain", the battlefield *landscape*
- □ Living *on* the "dirt"
- ☐ Traveling *across* the "dirt"
- □ Fighting *in* the "dirt"
- ☐ In Iraq this also means breathing the "dirt"

# "World Class Training for the Worlds Best Military" NTC – Ft. Irwin, CA

- ☐ Iraq warm desert
  warfare (eastern edge of Arabian desert)
- □ Goal training realism





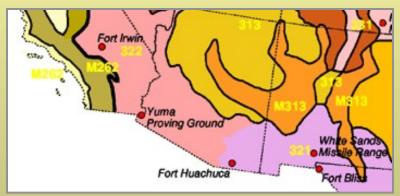
- Conflict area analogues
- Predict physical battlespace environment (effect on troops/ equipment)

# Warm Desert Global Characterization Model

(Hurley, et al., 2004)

Desert	Temp (F)	Precip (in/yr)	Dust Storm (freq)	Surface Terrain	Veg
Arabian	105, 38	4	High	4% af 26%sd 27% p 47% br	W
Saharan	110, 37	< 0.3	High	1% af 28% sd 23% p 43% br	W
Iranian	108, 24	4	High	26% af 19% sd 37% p 18% br	G
Mojave	105, 34	1-12 (5)	Very Low	32% af 1% sd 22% p 38% br	W
Sonoran	, 32	2-16 (2)	Low	32% af 1% sd 22% p 38% br	W
Chihuahuan	104, 27	2-12	Low	32 % af 1% sd 22% p 38% br	W

## Arabian Desert Conflict Area Analogues Checklist



- ✓ Sub-tropical, arid climate
- ✓ Fan/pediment systems, plains, exposed bedrock uplands
- ✓ Aeolian landforms/processes active, but localized
- ✓ "Key climatic factor…potential to produce dust" (Hurley, et al., 2004)
- ✓ No seasonal dust storms
- □ Playas/salt flats (sabkhas) more restricted or absent



## Particle Size Conventions

Phi Units*	Size V	Ventworth Size Clas	s Sediment/Rock Name
-8	256 mm	Boulders	Sediment: GRAVEL
		Cobbles	
-6	64 mm	Pebbles	Rock RUDITES: (conglomerates, breccias)
-2	4 mm	Granules	,
-1	2 mm		
0	1 mm	Very Coarse Sand	Sediment: SAND
1	1/2 mm	Coarse Sand	
2	1/4 mm	Medium Sand	Rocks: SANDSTONES (arenites, wackes)
		Fine Sand	
3	1/8 mm	Very Fine Sand	
4	1/16 mm	Silt	Sediment: MUD
8	1/256 mm		Rocks: LUTITES
* Udden-We	ntworth Sea	Clay	(mudrocks)

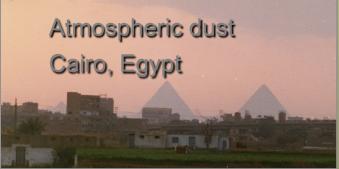
# "Key climatic factor...potential to produce dust"



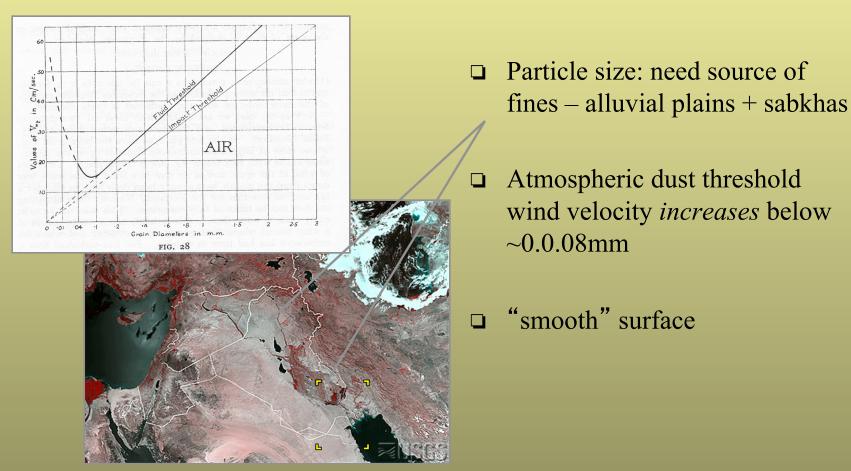
Atmospheric dust (0.001 to ~0.01mm) Sand ~ 0.08mm

Prevailing winds:
Northeasterly trades +
Southwesterlies

Seasonal winds: (siroccos, kahmsin shamals) + dust trajectories



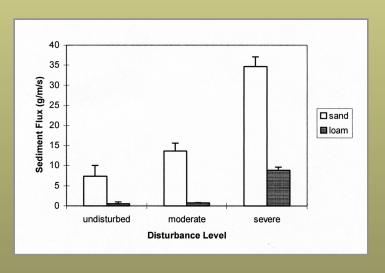
## Potential to Produce Dust: Critical Dust Source Emission Factors



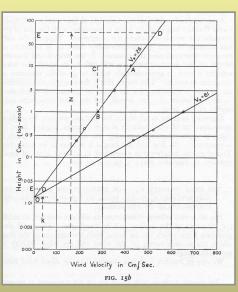
# Critical Dust Source Emission Factors



Surface roughness necessary to mobilize "dust"- size material



Disturbance creates surface roughness

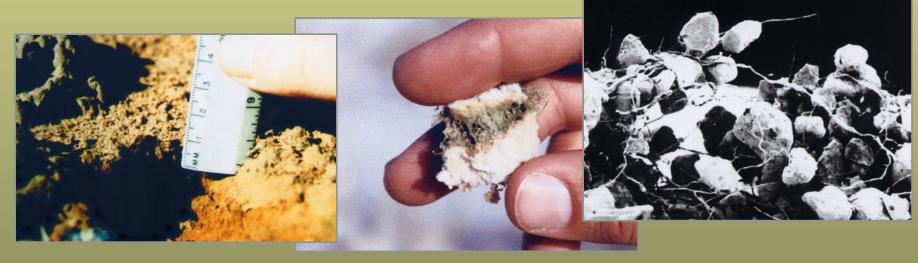


< 0.03mm fraction sinks "into viscid surface layer of air....out of reach....of eddies of turbulence" (Bagnold, 1984) "Biological setting can be significant, but can be considered less important than climate or physical setting in describing desert environments."

(Hurley, et al., 2004)

## Biotic Crusts: where the action is





# Collaborators

- USA Corp of Engineers
- Murray State University
- Mississippi State Univ.
- US Geological Survey
- Joint Pathology Center
- USAF Toxicology Det.
- Armed Forces Medical Examiners Office
- Vanderbilt University
- SUNY at Stony Brook
- National Jewish Health Center
- Office of Naval Research

- Navy Health Effects
  Research Detachment
- Office of Naval Research
- J. Craig Venter Institute
- **US EPA**
- University of Alaska at Fairbanks
- University of Cincinnati
- **NASA**
- University of California at Davis
- Chapman University









Brought to you by:

# Military com

New York Times - August 9, 2005

#### One More Affliction For Baghdad: A Day Of Blinding Dust And Grit & Breathlessness By James Glanz

BAGHDAD, Iraq, Aug. 8 - At dawn the atmosphere glowed orange, like the embers of a fire. Objects 25 yards away disappeared, as if a curtain had been drawn in front of them. Baghdad residents began waking up with the sour taste of grit in their mouths and a film of dust on their furniture and clothing, and by 8 a.m. Nireen Abdul Khalek began to feel that she could not breathe. Five hours later, Ms. Khalek, 24,

#### Research Workgroup Report

Health and Environmental Consequences of the World Trade Center Disaster

Philip J. Landrigan, Paul J. Lioy, George Thurston, Gertrud Berkowitz, L.C. Chen, Steven N. Chillrud, 4

Mice exposed to WTC dust showed only moderate pulmonary inflammation but marked bronchial hyper-reactivity. Evaluation of 10,116 firefighters showed exposure-related increases in cough and bronchial hyper-reactivity...... In summary, environmental exposures after the

WTC disaster were associated with significant adverse effects on h CENTRAL ASIA: Aral Sea crisis continues to erode health



## THE KOREA

#### Yellow Dust Storms Harmful to DNA

By Chung Ah-young Staff Reporter

Dust storms contain materials harmful enough to destroy a cell membrane, a red blood cell and even damage DNA, according to research released Wednesday.



© David Swanson/IRIN

Scores of ships remain stranded in the Aral Sea, once the fourth largest lake in the world

ANKARA, 26 Jul 2006 (IRIN) - Millions of people living near the Aral Sea face a bleak future, with health experts saying diseases like tuberculosis (TB) and cancer are having a terrible impact.

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wo or

The sea, located on the border of Kazakhstan and Uzbekistan, was once the fourth largest lake in the world. However, it continues to shrink despite regional commitments to halt the draining of the rivers that feed it. It is now a quarter of its original size.

Over the last 40 years an estimated 45 million mt of salt-contaminated dust has been created due to the shrinking, resulting in massive health problems that affect millions of people, experts say.

In 1994, the governments of Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan established the International Fund for

Saving the Aral Sea (IFAS) to address the environmental impact.

Usman Buranov, IFAS' technical director of the Global Environment Facility (GEF) projects, said that the health problems in the region were related to the low quality of drinking water.

He said agriculture and cattle breeding around the sea were less productive, unemployment was climbing and certain diseases were more prevalent.

The polluted air around the sea contained a toxic cocktail of salt, pesticides and chemicals that contaminated drinking water and led to liver and kidney illnesses, as well as a variety of respiratory diseases.

#### The Health Effects of Dusts

- **□** Some aspects have been well known for decades
  - General effects of industrial / commercial asbestos
  - Silicosis (hard rock mining)
  - Black lung (coal mining)
- New issues and problems are arising
  - Effects of mineral dust (ie, trace asbestos)
  - Valley fever (Coccidioidomycosis)
  - Trans-oceanic dust transport

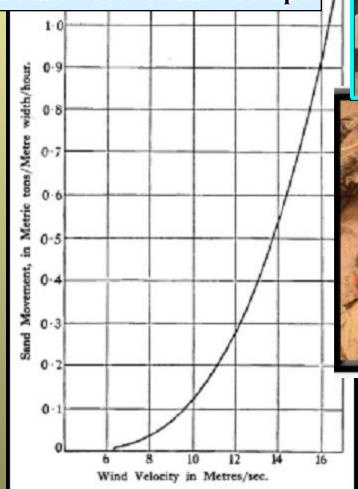


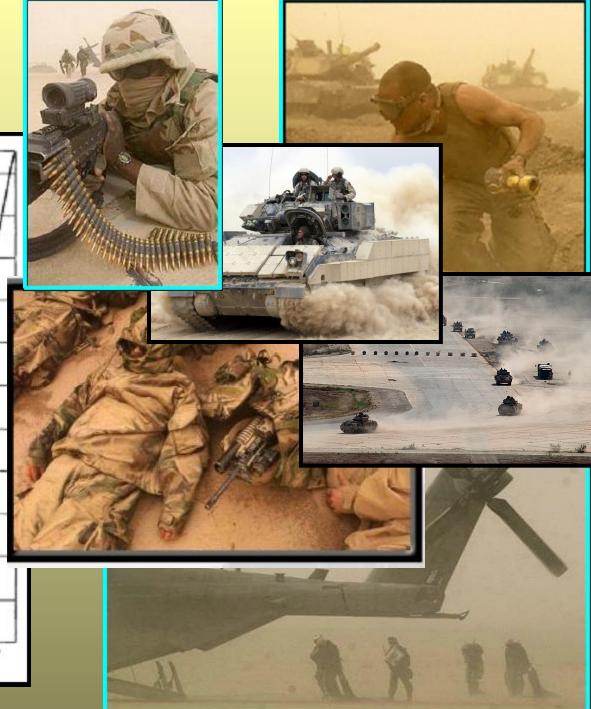




# Wind Velocity & Airborne Dust

10 m/s = 1968 ft/min = 22 mph 16 m/s = 3149 ft/min = 36 mph





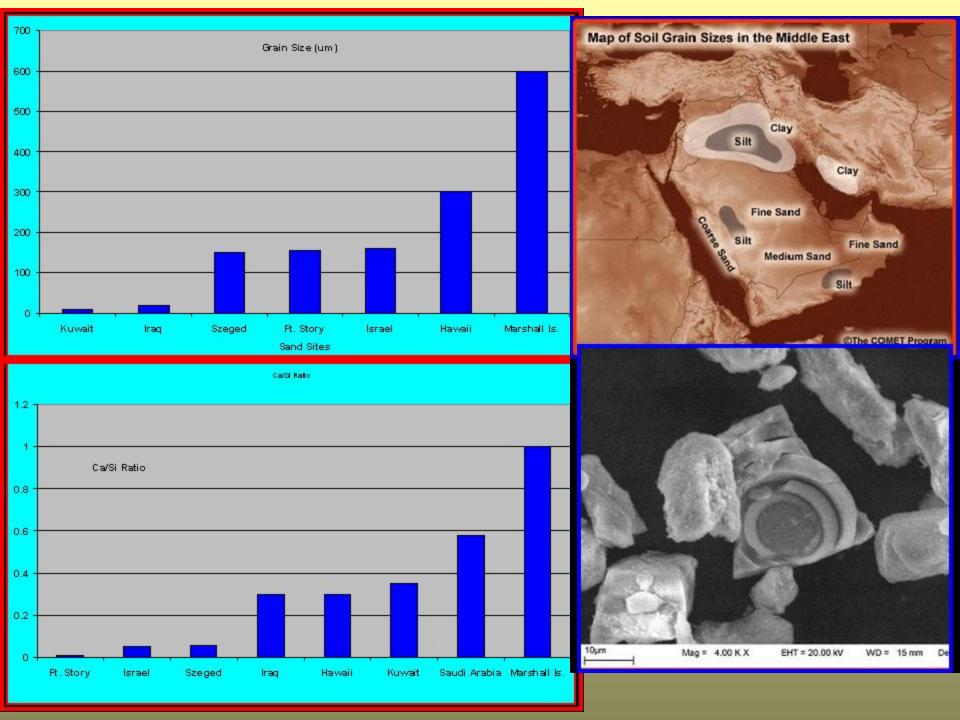
# Dust Exposure











#### **CENTCOM DUST: WHY IS IT IMPORTANT!**

- Force Health Protection Issues
  - Contains Heavy Metals
  - Harbors Pathogens
  - High Percentage in Respirable Range

#### **Exposure Issues**

- **≻**Contact
- >Ingestion
- **►**Inhalation

#### **CBD** Issues

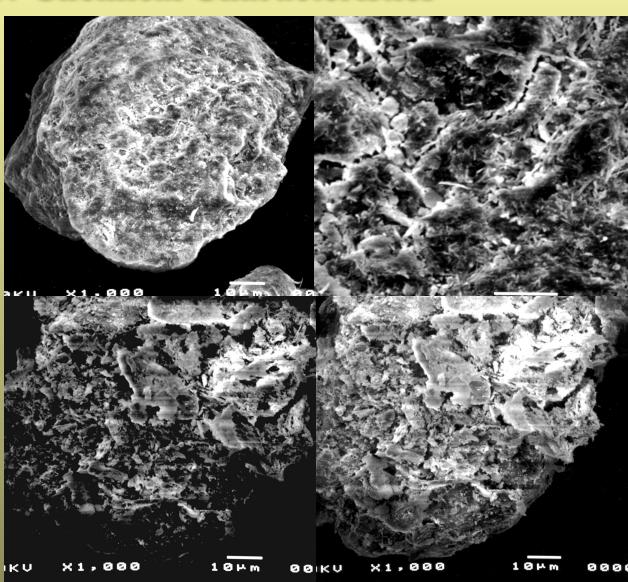
- > Detection
- >Analysis
- **≻**Contamination

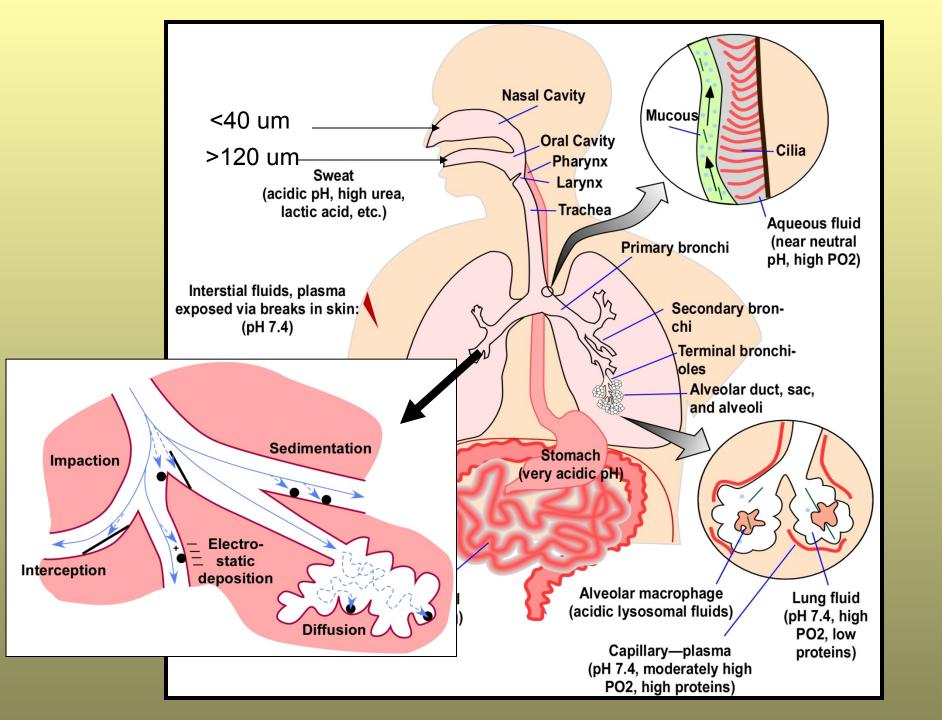




# Particle Dynamics Physical / Chemical Characteristics

- ✓ Widespread Distribution
- ✓ Hygroscopic
- ✓ Respirable
- ✓ Easily Airborne
- ✓ Non-clumping
- ✓ Bio-carrier





# Human Lung Airways

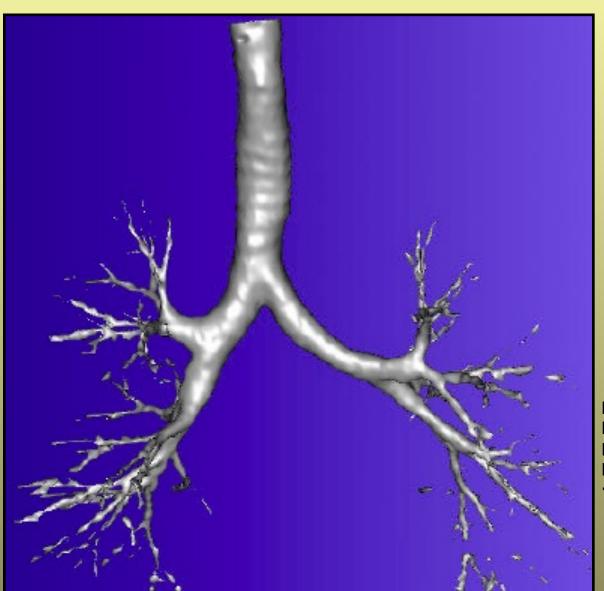
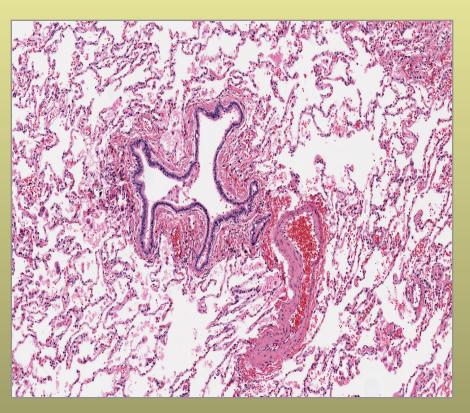
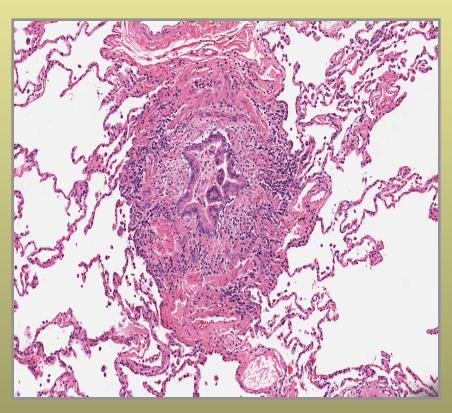


Image reconstructed from high resolution CT scan. Courtesy of Dr. Rod Clinkenbeard, University of Oklahoma

Moss, O. R. and Oldham, M. J. (2006). Dosimetry counts: Molecular hypersensitivity may not drive pulmonary hyperresponsiveness. J. Aerosol Med. 19(4), 555-564.

### Normal bronchiole Constrictive bronchiolitis













# **Summary of Exposure**

TSP (Total Suspended Particle Mass) (mg/m³) PM10 (10 um) and below

= 0.001 mg/m<sup>3</sup> (NIDBR Lab, Great Lakes, IL)

= **0.137 mg/m<sup>3</sup>** (Camp Virginia Clinic, Kuwait - indoors)

=  $2.469 \text{ mg/m}^3$  (Highest hourly average @1300)

=  $9.114 \text{ mg/m}^3$  (Highest TSP reading -18 June@1300)

=  $2.051 \text{ mg/m}^3$  (Highest daily maximum - 13 June)

#### Count (Total Number of Suspended PM 10 Particles /m<sup>3</sup>)

#### Size Range = 0.5 um to 10 um

= **1,314,906** (NIDBR Lab, Great Lakes, IL)

= **12,290,917** (Camp Virginia Clinic, Kuwait - indoors)

= 107,261,167 (Highest average hourly maximum @1300) (SD = 54,959,015)

= **588,633,693** (Highest daily maximum – 18 June@1300)

= **127,643,273** (Highest avg daily (0700-1900) max 13 June) (SD = 34,311,341)

\* NOTE: >20,000,000 counts /ft<sup>3</sup> readings recorded during peak dust storms or  $\frac{>706,293,334}{}$  particles per cubic meter.

#### Size Range = 5.0 um to 10 um

= **36,515** (NIDBR Lab, Great Lakes, IL)

= **507,824** (Camp Virginia Clinic, Kuwait - indoors)

= 6,884,417 (Highest average hourly maximum @1300) (SD = 4,142,586)

= **44,571,347** (Highest daily maximum - 18 June @1300)

= 5,244,651 (Highest average daily maximum - 13 June) (SD = 3,632,501)

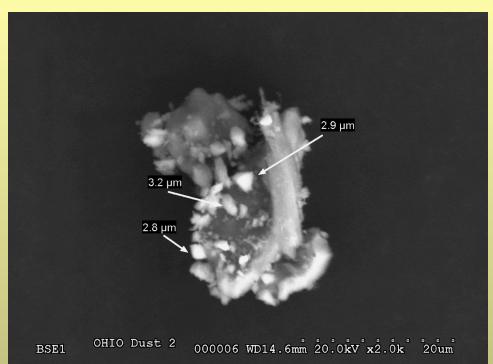
<sup>\*</sup> NOTE: >9.999 mg/m³ readings recorded during peak dust storms

# Chemical Analysis: Heavy Metals

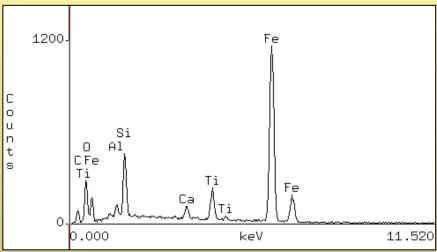
# Acid Extractables Tent 1

EPA method is SW-846 6010 for ICP-AES and 6020 for ICP-MS. EPA digestion method-3050.

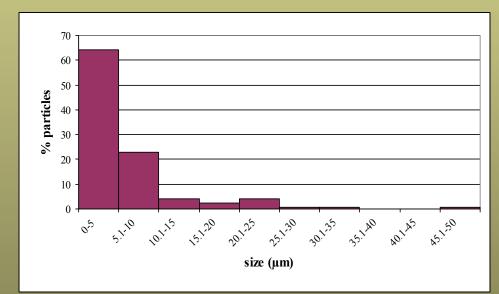
Sample	>120um	>90um	> 63um	>44um	>20um	<20um
Mass	0.2627	0.2596	0.2488	0.2626	0.2441	0.2504
Element	% dry wt	%dry wt				
Sr	0.0697	0.0642	0.0995	0.1978	0.2718	0.2436
Ba	0.0068	0.0072	0.0081	0.0192	0.0308	0.0463
P	0.0160	0.0170	0.0234	0.0433	0.0549	0.0649
S	2.4413	2.4230	3.0444	4.0062	3.6646	3.0458
Mg	0.6844	0.8718	1.2672	1.5505	1.7234	1.7784
V	0.0022	0.0026	0.0032	0.0041	0.0046	0.0049
Na	0.1759	0.1963	0.1672	0.2056	0.2123	0.2225
Al	0.2969	0.3832	0.4948	0.6351	0.7164	0.7521
Ca	9.0134	10.3057	11.7495	13.9148	15.3535	16.7133
Zn	0.0053	0.0039	0.0042	0.0070	0.0112	0.0206
Cu	0.0060	0.0050	0.0036	0.0054	0.0077	0.0268
Ni	0.0089	0.0094	0.0169	0.0197	0.0305	0.0564
Y	0.0009	0.0006	0.0006	0.0007	0.0009	0.0010
K	0.0502	0.0653	0.0612	0.0942	0.1186	0.1422
Mn	0.0174	0.0222	0.0268	0.0305	0.0331	0.0352
Fe	0.3506	0.4844	0.6889	0.8419	0.9601	0.9736
Cr	0.0027	0.0032	0.0039	0.0049	0.0052	0.0052
Pb	0.0111	0.0038	0.0049	0.0056	0.0076	0.0138



#### Middle East Desert dust



# particles	123
average (μm)	6.4
median (μm)	4.3
max (μm)	46.1
min (μm)	1.1



Centeno JC, Lyles ML, et al. unpublished results, 2011

#### **Middle East Dust – Trace Composition**

Links between selected elements and some known lung function conditions and diseases

Elliks between selected elements and some	Desert Dust <10 μm	Desert Dust 20-40 μm
Mn (ppm)	450	331.98
Fe (ppm)	25500	18111.61
Co (ppm)	11.72	8.24
Pb (ppm)	17.22	9.45
Cu (ppm)	220	152.64
Cd (ppm)	1.24	0.70
Mg (ppm)	13230.49	10572.70
Al (ppm)	15912.39	13154.60
Ca (ppm)	139577.64	140250.15
Na (ppm)	1098.28	1476.86
Cr (ppm) [but species critical]	181.32	187.36
Zn (ppm)	105.18	72.30
Ni (ppm)	93.28	60.44
Ti (ppm)	1095.52	539.81

Cancer

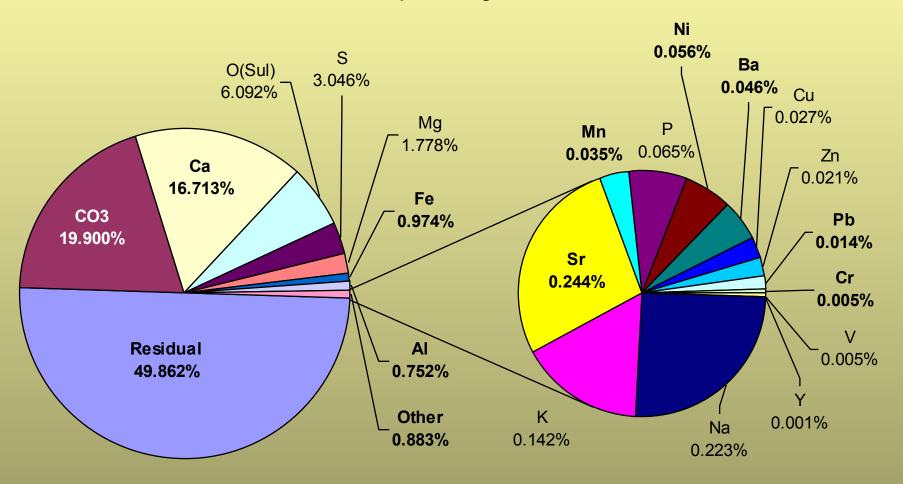
Cancer suspected

Cancer & asthma

Emphysema

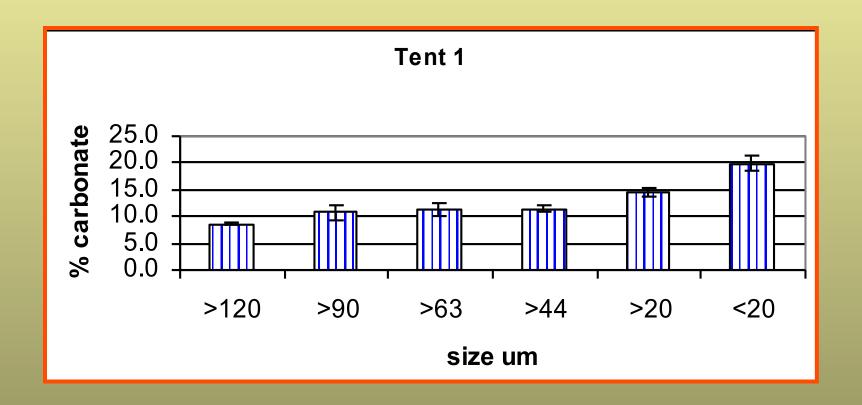
Asthma

#### <20 um Camp Buehring



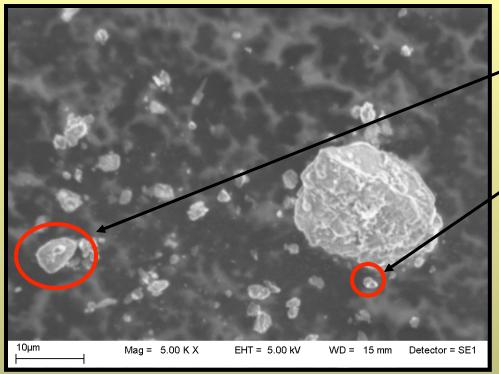
EPA method is SW-846 6010 for ICP-AES and 6020 for ICP-MS. EPA digestion method, 3050.

# **Chemical Analysis: Carbonates**



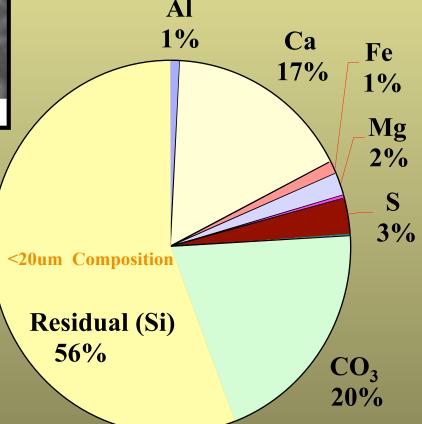
## **Initial Conclusions**

- > Cd, Se do not differentiate by site
- As, Co, Ni, Cr, Pb contents show significant differentiation by site
- Sites S127004 and S127011(site clusters 5,6) are distinct outliers from the general population of sampled sites
- > Site clusters 4,5,6 "elevated" As, Cr
- Possible Pb-Mn association



400 of these particles can fit end-to-end across the Head of a Pin.

800 - 1000 of these particles can fit on the Head of a Pin.



### **Summary**

- As particle size decreases, % heavy metals increases.
- Over or near maximum exposure levels for many metals.
- Significant daily loading of trace metals possible.

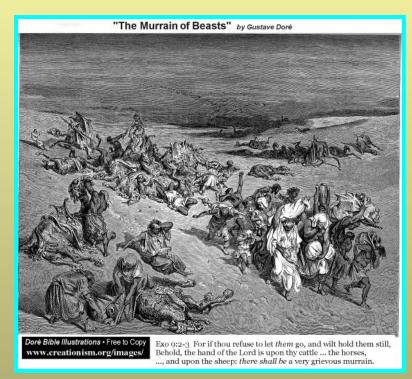
### Microbiological Study of Micro-particulates

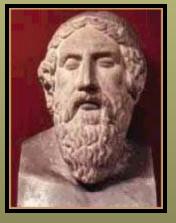
Sixth Plague of Egypt – "Murrain of beasts" Exodus 9:6

Sixth Plague of Egypt – "And it shall become small <u>dust</u> in all the land of Egypt, and shall be a boil breaking forth [with] blains upon man, and upon beast, throughout all the land of Egypt". Exodus 9:10

### 25 BC: Poet Virgil

- The Iliad (Homer), "the burning wing of plague..."
- Middle Ages: European pandemic "Black Bane" killed 60,000 cattle.









## Culturettes



~32 samples X 6 types of Culturettes = ~192 Culturettes



**Black** Aerobic & Anaerobic with Charcoal

Blue Aerobic & Anaerobic without Charcoal

Green Industrial quality control

Mico Fungi

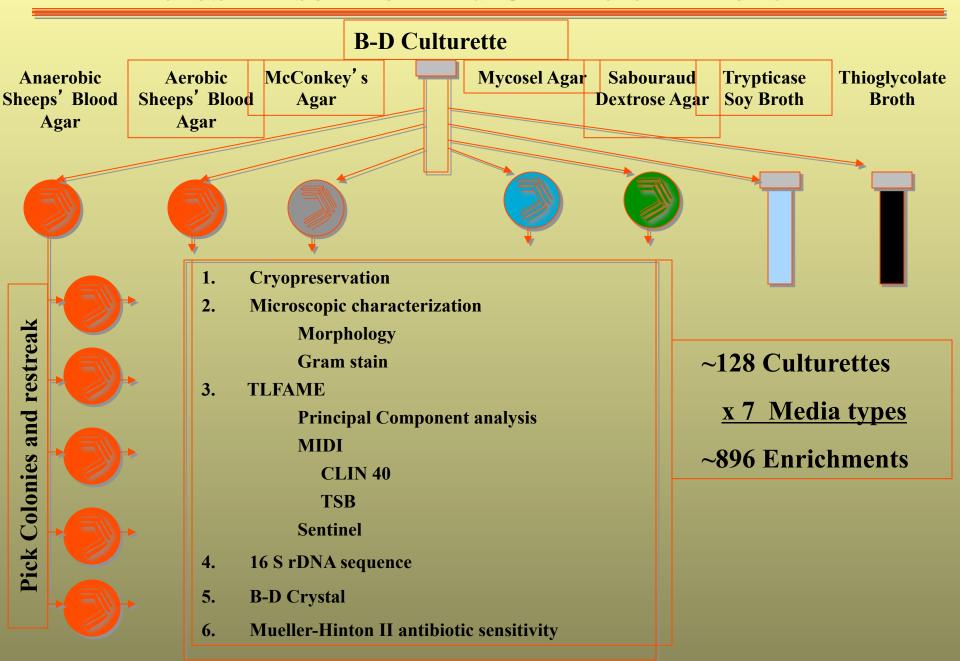
Yellow Chlamydia

Green Virus

Stored at 3°C

 $\sim$ 32 samples X 4 types of Culturettes =  $\sim$ 128 Culturettes

### Microbial Isolation and Characterizations



## **Summary of Soil Isolates**

Best ID thus Far	Comment	
	N	
Neisseria meningiditis	meningitis	
Staphylococcus aureus	cystic fibrosis	301
Bacillus circulans	gastro-enteritis	and all latter
Pantoea agglomerans	septic arthritis	<b>新州市</b> (1977年)
Pseudomonas agrici		AMOUNT HALL
Ralstonia paucula	opportunist-septicemia, peritonitis, abscesses	067 1117
Staphylococcus pasteuri	various infections	
Arthrobacter crystallopoietes		De Carolina
Pseudomonas balearica	cystic fibrosis	
Paenibacillus thiaminolyticus	bacteremia	
Bacillus vedderi	obligate alkaliphile	
Bacillus subtilis		664555
Pantoea agglomerans	epiphyte	
Pseudomonas pseudoalcaligenes		378355
Cryptococcus albidus	septicemia and meningitis	
Bacillus clausii	Oral bacteriotherapy	
Kurthia gibsonii	Diarrhea	
Bacillus firmus	alkaliphile; bread spoilage	
Staphylococcus kloosii	various infections	
Bacillus mojavensis	biosurfactant	
Bacillus licheniformis	food poisoning	
Pseudomonas oryzihabitans	Hickman catherter biofilm	



## Culturettes

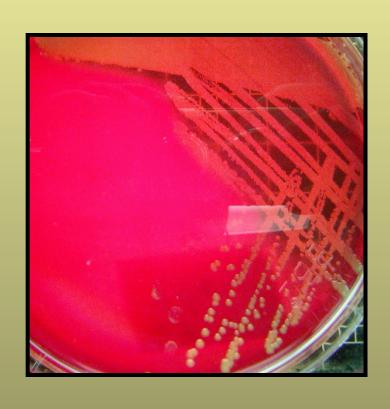


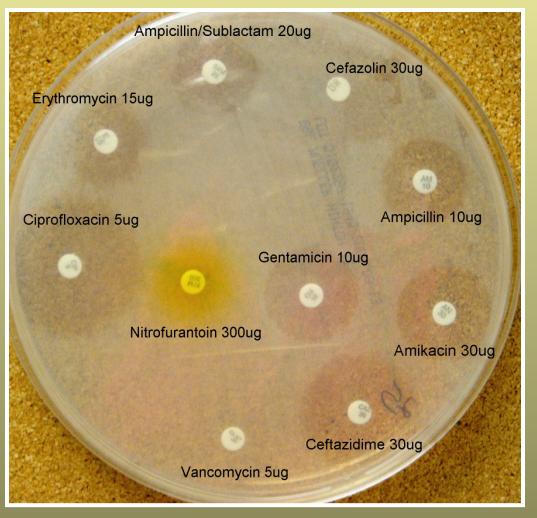
## **Isolates of Concern - Hemolytic**

						Genus and	Specie	es Identification			
Isolate								TLFAME			
Number	Location	Culturette	Hemolytic	16S	Match	CLIN 40	Match	Sentinel	Match	TSB	Match
56	Kuwait 2	Blue	Beta	Submitted		Legionella vjordanis	0.16	Microbacterium luteolum	0.25	Microbacterium-liquefaciens*	0.42
69	Kuwait 2	Black	Beta	Submitted		Micrococcus luteus G	0.80	Arthrobacter luteolus	0.49	Arthrobacter-atrocyaneus	0.69
70	Kuwait 2	Blue	Beta	Submitted		Micrococcus luteus C	0.81	Arthrobacter luteolus	0.54	Arthrobacter-atrocyaneus	0.68
72	Kuwait 2	Blue	Beta	Submitted		Tatlockia micdadei*	0.26	Arthrobacter oxydans	0.04	NO MATCH	
I-10	Udari	Orange	Alpha	Pantoea agglomerans	0.95	Neisseria cinera	0.20	Providencia rettgeri	0.02	Ewingella americana	0.78
I-11	Udari	Blue	Alpha	Pseudomonas agrici	0.01	No data		No data		Pseudomonas stutzeri	0.90
I-17	Udari	Black	Alpha/Beta	Paenibacillus thiaminolyticus	0.03	No data		No data		Paenibacillus thiaminolyticus	0.53
I-18	Udari	Orange	Beta	Submitted		Bacillus subtilis	0.52			Bacillus subtilis	0.90
l19	Udari	Blue	Beta/Alpha	Bacillus subtillis subtillis	0.00	No data		No data		Bacillus subtilis	0.92
I-20	Udari	Green	Alpha	Pantoea agglomerans	0.01	Pantoea aggomerans	0.62	Ralstonia paucula	0.27	Pantoea agglomerans	0.82
I-30	Tallil AB	Orange	Beta	Bacillus mojavensis	0.00	Bacillus subtilis	0.42	No Match		Bacillus atrophaeus	0.87
I-31	Tallil AB	Blue	Beta	Bacillus licheniformis	0.02	No data		No data		Bacillus licheniformis	0.61
I-32	Tallil AB	Green	Beta	Flavimonas oryzihabitans	0.00	No data		No data		No data	

## **Antibiotic Sensitivity**

### **Beta Hemolytic Isolate Number 69**





# Bacteria Isolated from Kuwait and Iraq that have Shown Antibiotic Resistance.

Culture#	Description	Location	Culturette	Hemolysis	Colony Morphology	MIDI@DE	Similarity	Comment
					A TOTAL OF THE PARTY OF THE PAR	Environmental	Index	
8	BSSI	Babylon	Green	No	Dry Fungal type colonies;	Bacillus circulans	0.61	N/A
	1111000000	The state of the s			White spreader on TSA & Blood	TEMPONENCIA ANTONIO ANTO	1000000	
12	>20<44 um	Udairi	Green	No	Cream colored mucoid colonies on Blood and TSA;	Not growing when others sent off	NA	N/A
16	>44<63 um	Udairi	Green	No	Small mucoid colonies on Blood;	Staphylococcus warneri	0.881	N/A
					Spreading mucoid on TSA;			
20	>44<90 um	Udairi	Green	alpha	Small dry cream colored colonies	Pantoea agglomerans	0.82	GC subgroupB
						Pantoea agglomerans	0.711	GC subgroupC
24	<20 um	Udairi	Green	No	Shiny yellowish/cream spreading colonies on TSA;			
					Purple spreader on Blood;			
28	TAB II Sand A	Tallil	Green	No	Large shiny mucdid colonies	Not sent to MIDI	NA	N/A
32	TAB II Sand B	Tallil	Green	beta	Clear white cauliflower colony on TSA;	Not sent to MIDI	NA	N/A
					Shiny clear runny colony on Blood			
								1
Culture#	MIDI@MS	Simil arity	Comment	MIDI@MS	Similarity	MIDI 500 bp rDNA sequince an	alysis	Comments
	CLIN 40	Index		Sentenial	Index	NSA 191	% Diff	
8	No match/Too dilute	NA	N/A	No match				
12	Vibrio alginolyticus	0.366	N/A	Ralstonia paucula	0.127			
	Aeromonas hydrophilia	0.366	N/A	Erwinia mallotivora	0.103			
16	Pseudomonas stutzeri	0.44	N/A	Pseudomonas balearida	0.097			
					10000000			
20	Pantoe aggomerans	0.623	Csubgroup	Ralstonia paucula	0.274	Pantoea agglomerans	0.85%	Plant/Human
10,000	Aeromonas hydrophilia	0.386	N/A	Buttiauxella gaviniae	0.175			Pathogen

Flavimonas oryzinabitans

Pathogen

24

NA

NA

Not Extracted

Not Extracted

N/A

N/A



## **Fungal Isolates**



## ~300 bp of D2 region of LSU rDNA

Microseq Library database				
Midi D2(300 bp)LSU rRNA	% diff	LSU D2 Genbank Database	% ID	Associated Disease
Allewia eureka	0.31	Ulocladium sp.	99	
Allewia eureka	4.64	Cryptococcus uzbekistanensis	100	
Allewia eureka	0.31	Ulocladium sp.	99	Unknown
Altemaria altemata	0	Alternaria sp	100	Plant pathogen
Rhodotorula minuata	5.73	Rhodotorula minuata	99	Eye infections
Cryptococcus albidus	2.44	Cryptococcus sp.	100	Cryptococcus neoformans - meningoencephalitis
Ulocladium chartarum	0.31	Stemphylium sp	99	Fungal biocontrol agent
Filobasidium uniguttulatum	4.64	Cryptococcus uzbekistanensis	100	Teleomorph of Crytococcus, non pathogenic yeast
Ulocladium consortiale	0	Stemphylium sp	100	Cutaneous mycoses
Ulocladium chartarum	0.31	Stemphylium sp	99	
Mortierella polycephala	7.1	Mortierella polycephala	92	Pulmonary mycosis in cattle
Embellisia chlamydospora	0	Ulocladium sp.	99	Unknown
Filobasidium uniguttulatum	4.64	Cryptococcus uzbekistanensis	100	
Penicillium camembertii	0	Penicillium sp.	100	
Cryptococcus albidus	0	Cryptococcus albidus	100	
Allewia eureka	0.31	Ulocladium sp.	99	
Embellisia chlamydospora	0	Ulocladium sp.	99	
Filobasidium uniguttulatum	4.64	Cryptococcus uzbekistanensis	100	
Embellisia chlamydospora	0	Ulocladium sp.	99	
Filobasidium uniguttulatum	4.64	Cryptococcus uzbekistanensis	100	
Penicillium camembertii	0	Penicillium sp.	100	
Allewia eureka	0.31	Ulocladium sp.	99	Plant pathogen
Phoma glomerata	0	Phoma herbarum	99	

### **Microbiology Summary**

NO.	Site	Hemolysis	MIDI @ DE	imilari	MIDI @ MS	imilarii	MIDI @ MS	Similarit	MIDI 500 bp rDNA sequnce	e analysi:	s	Best ID thus Far
		on Blood aga	_	Index	_	Index	Sentenial	Index	% Difference			
		l light	Database ID		Database ID		Database ID			,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		
2	Babylon	No	Pseudomonas stutzeri	0.597	Pseudomonas stutzeri	0.503	Neisseria meningitis	0.357				Neisseria meningitis
							Neisseria meningitis	0.29				3
							Neisseria cinerea	0.29				
5	Babylon	No	Staphylococcus epidermidis	0.827	Staphylococcus aureus	0.676	Staphylococcus aureus	0.609				Staphylococcus aureus
			Staphylococcus epidermidis	0.78	Staphylococcus warneri	0.596	Staphyloccoccus epiderimidis	0.576				
			Staphylococcus capitis	0.753	Staphylococcus aureus	0.569	Staphyloccoccus hominis	0.497				
8	Babylon	No	Bacillus circulans	0.61	No match/Too dilute	N/A	No match					Bacillus circulans
9	Udairi	Alpha hemoly	Not sent to MIDI	N/A	Not Extracted	N/A						None
10	Udairi	Alpha hemoly	Ewingella americana	0.778	Neisseria cinera		Providencia rettgeri	0.023	Pantoea agglomerans	0.95%	Species	Pantoea agglomerans
			Salmonella typhimurium		Aeromonas veronii		Arcobacter skirrowii	0.018				
			Pantoea agglomerans	0.568	Neisseria cinera	0.169	Erwinia amylovora	0.017				
11	Udairi	Alpha hemoly	Pseudomonas stutzeri	0.896	Not Extracted	N/A			Pseudomonas agrici	1.34%	Genus	Pseudomonas agrici
				0.659								
			Pseudomonas resinovorans	0.584								
12	Udairi	No	Not growing when others	N/A	Vibrio alginolyticus		Ralstonia paucula	0.127				Ralstonia paucula
					Aeromonas hydrophilia		Erwinia mallotivora	0.103				
					Neisseria mucosa	0.335	Ralstonia basilensis	0.1				
14	Udairi	No	Not growing when others	N/A	Staphyloccoccus epiderimidis	0.419	Staphylococcus pasteuri	0.207				Staphylococcus pasteuri
							Staphylococcus caprae	0.185				
_							Staphylococcus warneri	0.135				
45	I faladai	N-	Minerile and the second at the second	0.077	Desillos sessolases	0.400	A	0.444	Author boots a second law of	0.0004	0	Arthropostor oprotollons is to
15	Udairi		Virgibacillus pantothenticus Micrococcus luteus		Bacillus coagulans  Dermobacter hominis		Arthrobacter atrocyaneus	0.414	Arthrobacter crystallopoietes	0.00%	Species	Arthrobacter crystallopoietes
-						0.327	Agromyces ramosus	0.283				
			Bacillus atropheus	0.477	Kocuria-varians(Micrococcus)	0.516						
16	Udairi	No	Staphylococcus warneri	0.991	Pseudomonas stutzeri	0.44	Pseudomonas balearica	0.097				Pseudomonas balearica
10	Ouaiii	INU	Staphylococcus epidermidis	0.754		0.44 N/A	r Seudomonas Daleanca	0.097				r seudomonas paleanca
			Staphylococcus epidermidis			N/A						
			Staphylococcus epidermidis	0.01	IN/A	IN/A						
17	Udairi	Beta/Alpha	Paenibacillus thiaminolyticus	0.534	Not Extracted	N/A			Paenibacillus thiaminolyticus	2 07%	Genus	Paenibacillus thiaminolyticus
17	Guairi		•	0.464	NUL EXITACION	IN//A			T acriibaciilas tillallillolyticus	2.3170	Genus	Tacinizacinas unaniniciyucus
			Daonius auropriaeus	0.404								
18	Udairi	Reta hemolyti	Bacillus subtilis	0 001	Bacillus subtilis	0.52	Bacillus vedderi	0.656				Bacillus vedderi
10	Guairi		Bacillus atrophaeus	0.697			Bacillus mojavensis	0.642				Ducinus veduen
			Dacilius all'Opriaeus	0.097	IN/A	IN/A	Dacilius IIIUjavelisis	0.042				



## Dust – Pad 15 PM<sub>10-20</sub>



Agar Enrichments – Comparison of media/methods

Chocolate Sheeps' Red Cell Trypticase Soy







**Swab Dust** 



## Dust

## Particle size – media comparisons

Chocolate

Sheeps' Red Cell Trypticase Soy

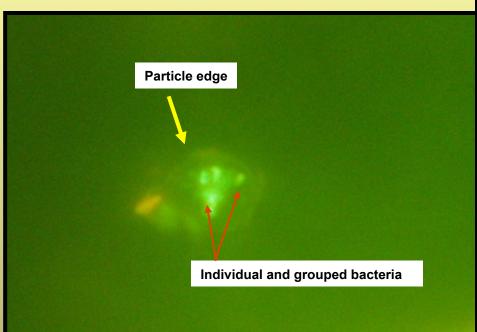




Pad 15 PM<sub>20-40</sub>

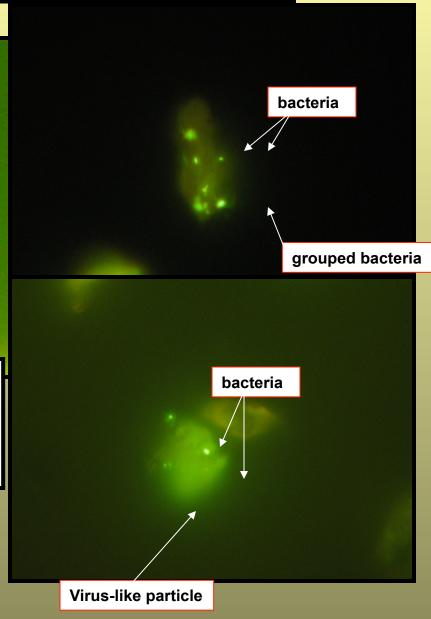


### Kuwait dust, Camp Buehring, size fraction 10 to 20um

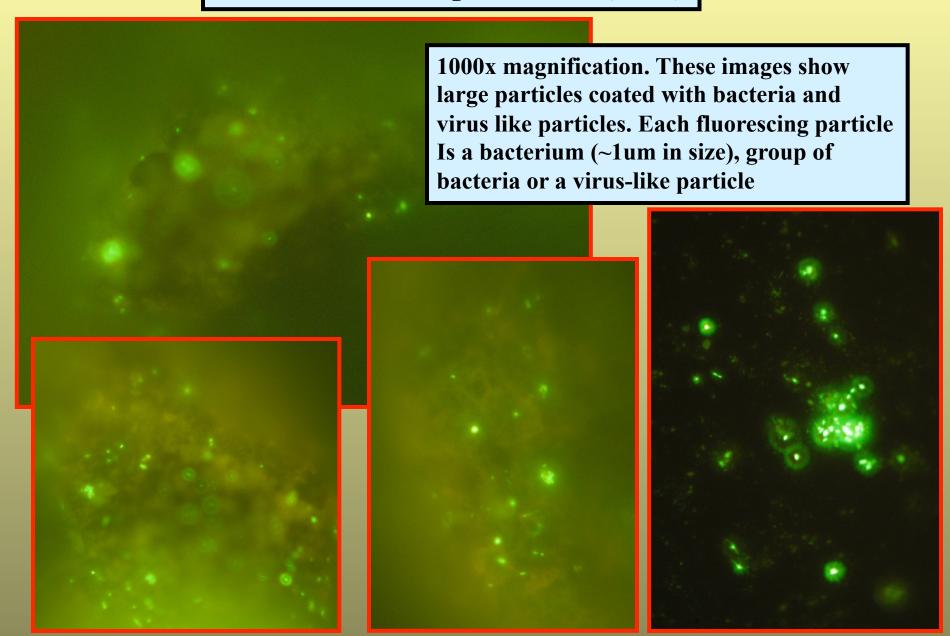


This photo shows a particle that appears to contain numerous bacteria in its core rather than on its surface. Bacteria size ~1um. 1000X with digital zoom.

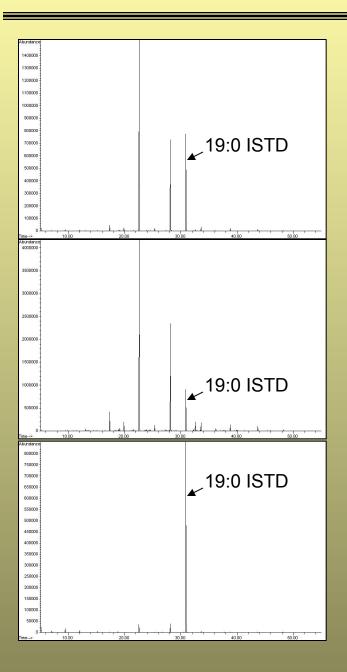
**Sterilization Problems!** 



### Kuwait dust, sample #2 raw (bulk)



### **PLFA Biomass of Iraq Dust Samples**



Sample PLFA biomass Description nmol/g cells/g

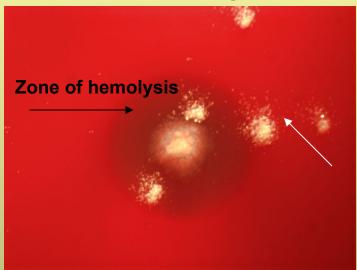
Tent1 6A > 20 14.6 3.64e11

Bacillus cereus 0.37% (Anthracis?)

Tent2 6B > 20 0.45 1.13e10 Bacillus circulans 0.19%

### Sprinkle particles (> 20 µm) onto agar

### Sheeps' Blood Agar



Many zones of hemolysis but very poor colony development.

Trypticase Soy Agar

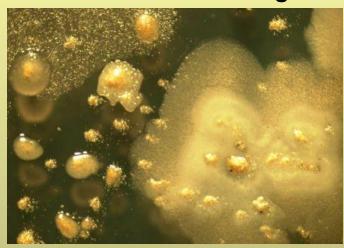




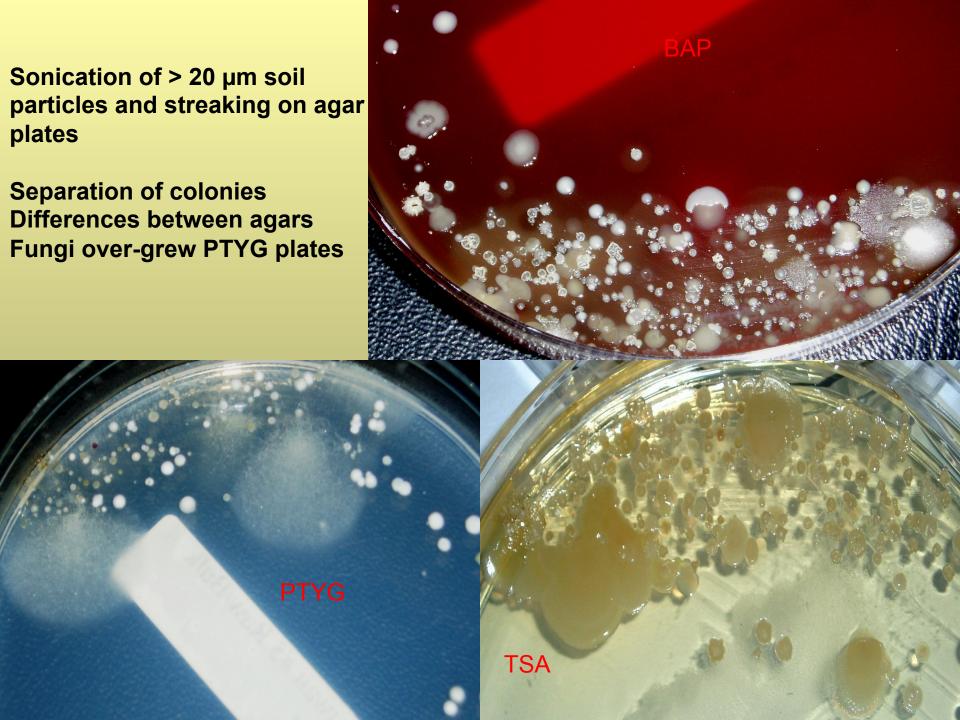




**Low Nutrient PTYG Agar** 

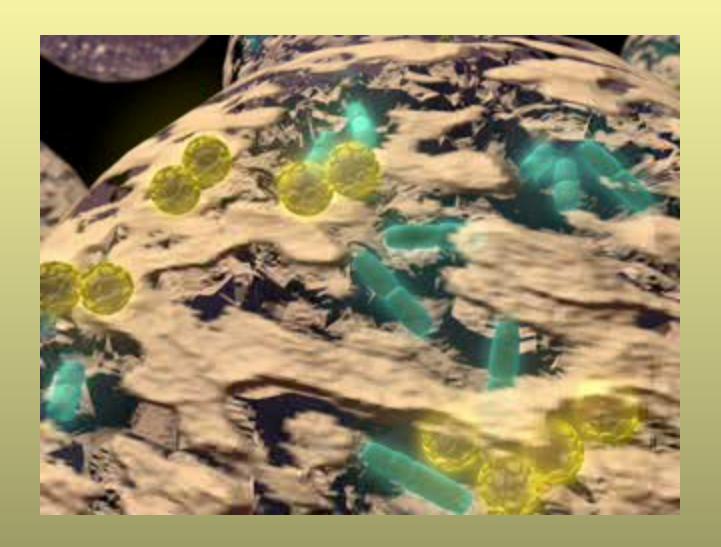


Poor colony separation and fungi over grew plates after 48 hours.



## VIRUSES



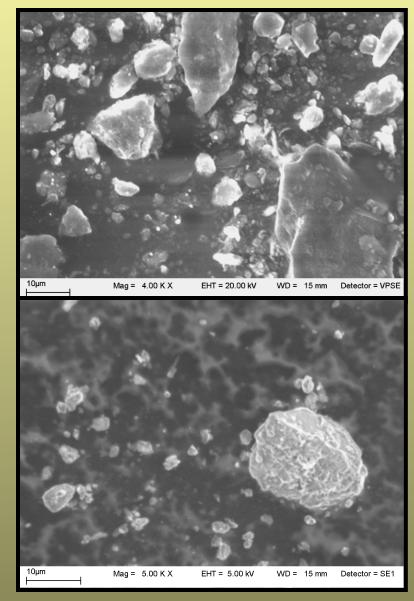


## Summary of Scientific Results

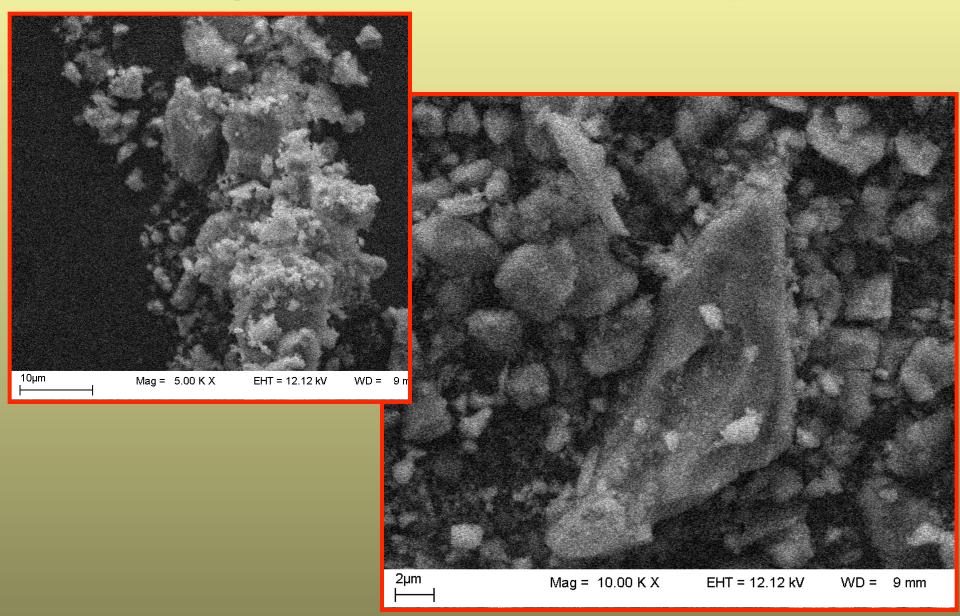
- Approximately 147 different isolates identified to date (6 Genera by 16s DNA analysis). 13 alpha/beta hemolytic species have been identified and 27 fungal isolates have been identified (7 different Genera). Several species have shown antibiotic resistance. More are expected from the low nutrient studies.
- Acinetobacter spp. has been identified by FAME analysis, but species yet to be determined.
- We have 6 isolates of *Neisseria* with FAME analysis.
- A total of 54 elements were screened for with 37 different elements identified of which 15 are bioactive metals including Uranium. Of these the ones of greatest concern are: Arsenic (10 ppm), Chromium (52 ppm), Lead (138 ppm), Nickel (564 ppm), Cobalt (10 ppm), Strontium (2700 ppm), Tin (8 ppm), Vanadium (55 ppm), Zinc (194 ppm), Manganese (369 ppm), Barium (327 ppm), Aluminum (9400 ppm).
- Elemental data suggests that minerals and elements tend to cluster geochemically within sites, and there are significant geochemical differences between some of the sites that seem to impact presence of specific toxic trace metals and their concentrations in the dust/dirt.
- > Sterilization Experiments suggest an exceptional ability for microbes to survive.
- Early animal studies have suggested long term inflammation with mild to moderate eosinophilia.

## This is NOT sand...It's DUST!

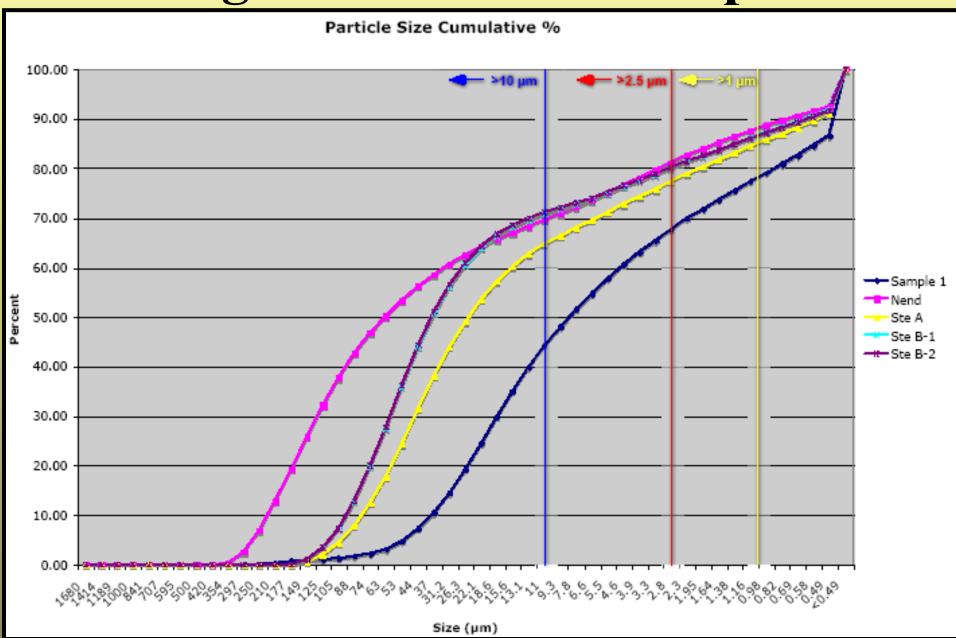
- These <u>micro-particulates</u> are composed of a porous silica core (crystalline metallic silica and amorphous silica dioxide) surrounded by a type of clay consisting of, primarily, Calcium Carbonate (CaCO<sub>3</sub>) and Magnesium Sulfate (MgSO<sub>4</sub>).
- The laminar nature of the clay coating greatly magnifies the surface area and contributes to the hygroscopic nature of the particle.
- The micro-particulates act as a protective coating and carrier for the micro-organisms.

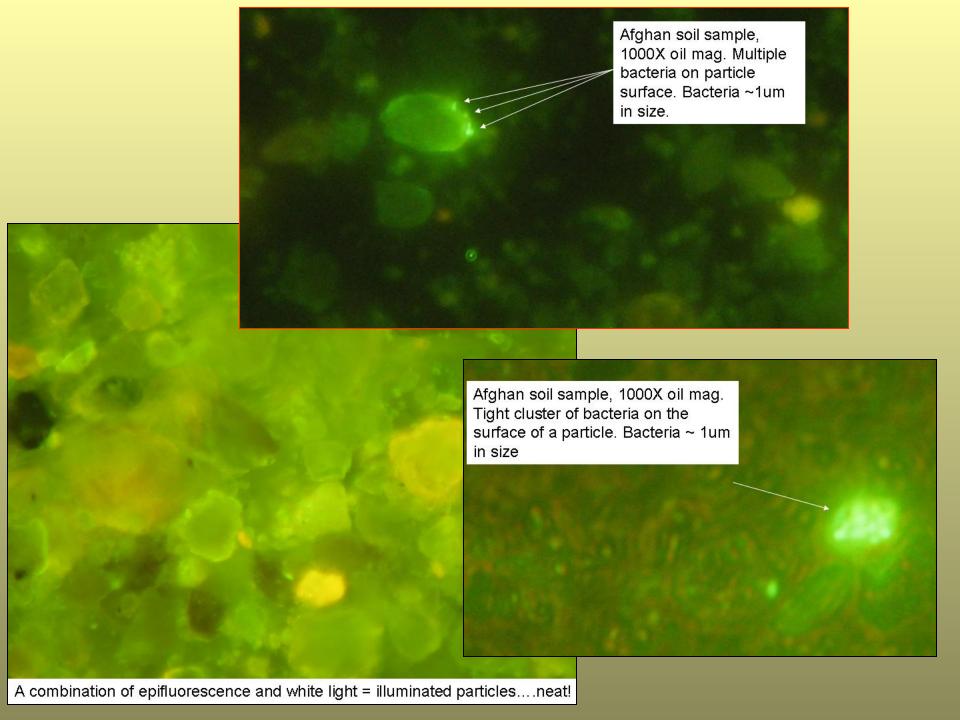


## Afghanistan Dust Sample



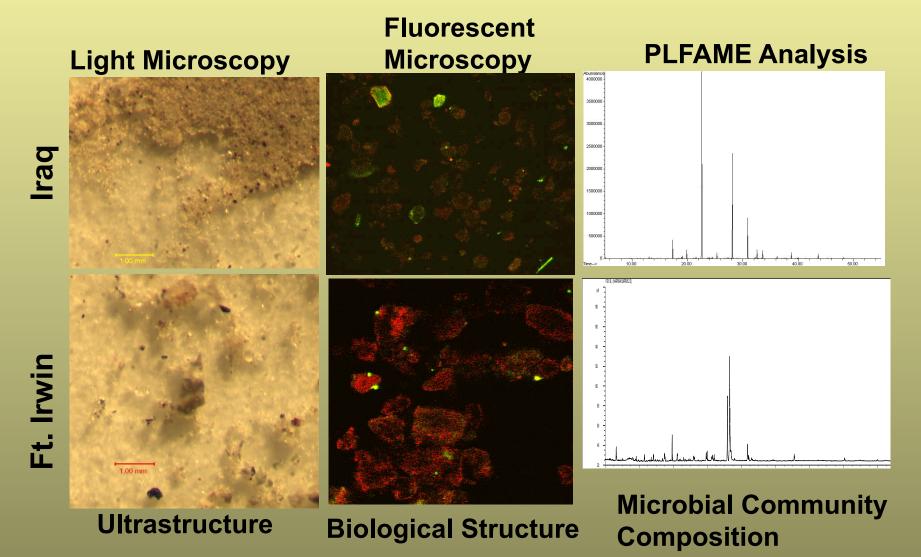
## Afghanistan Dust Sample





## **COMPARISONS**

Laboratory Comparisons of Iraqi and Ft. Irwin Dust initiated



## The Problem....

Environmental dust from the Middle East is ubiquitous and human exposure is extremely high.

These particulates ARE inhabited by bacteria, fungi, and viruses.... And they contain a variety of bioaccessible metals posing a significant hazard.

➤ What are the health risks????













## Recent Reports and Data..



#### MEDICAL GEOLOGY: DUST EXPOSURE AND POTENTIAL HEALTH RISKS IN THE MIDDLE EAST

MARK B. LYLES

viruses.

Research Program Integration and Mission Development, Bureau of Medicine and Surgery, Washington, DC, USA

In the Middle East, dust and sand storms are a persistent problem and can deliver significant amounts of micro-particulate exposure via inhalation into the mouth, nasal pharynx, and lungs due to the fine size and abundance of these micro-particulates. The chronic and acute health risks of this dust inhalation have not been well studied nor has the dust been effectively characterized as to chemical composition, mineral content, or microbial flora. Scientific experiments were therefore designed to study the Kuwaiti and Iraqi dust as to its physical, chemical, and biological characteristics and for its potential to cause adverse health effects. First, dust samples from different locations were collected and processed and exposure data collected. Initial chemical and physical characterization of each sample including particle size distribution and inorg Army Times 12/13/2010 followed by characterization of biologic flora of the dust, i

Dust can range in both composition and particle s location. In the Middle East, dust and sand storms are a p during the spring and summer months. Desert sand in the mostly of quartz (SiO2) but the finer dust consists primarily silicate core and can be respired into the lungs due to the respired into th (Richards et al. 1993). The dust particles predominately c quartz crystals (~25%). The size distribution of airborne par to ~150+ µm depending on wind velocity.

Inhabitants of deserts can develop Desert Lung progressive fibrosis resulting from silica-containing dust de Lung Syndrome generally develops after years of heavy (Nouh, 1989). An acute desert-related lung disease of Pneumonitis was found to occur following inhalation of droppings (Korenyi-Both et al. 1992). In a second paper describe a novel condition triggered by exceptionally fine sa Saudi Arabian peninsula (Korenyi-Both et al. 199 immunosuppression aggravated by opportunistic infection ailments were brought on by exposure to the ubiquitous f Persian Gulf Syndrome (Korenyi-Both et al. 1997).

**NavyTimes** 

http://www.navytimes.com/news/2010/07/navy\_toxic\_dust\_071210w/

### Study finds toxic metals in dust in Afghanistan

By Andrew Tilghman - Staff writer

Posted: Monday Jul 12, 2010 7:41:46 EDT

Here's another thing to worry about when you deploy: toxic dust.

A new Navy study suggests that dust from Afghanistan contains metals that may cause respiratory problems and brain damage.

"Afghanistan sand produces neurotoxicity ... with potential adverse health effects to our soldiers," according to a briefing of the study presented at a medical conference in June in Portland, Ore.

The Navy conducted the study in response to anecdotal concerns that the dust and dust storms common in the Middle East may be harmful. The dust samples were taken from Forward Operating Base Salerno near Khost, which was selected because of its relative isolation with no nearby industry that could skew results.

A close analysis of the Afghan dust found traces of manganese, a toxic chemical known to cause Parkinson's-like symptoms. Other metals found in the sand include silicon, iron, magnesium, aluminum and chromium.

### Iraq, Kuwait dust may carry dangerous elements

that troops' exposure could lead to heart and lung ailments

#### kellylennedy@militerytimes.com

Researchers studying dust in Iraq and Kuwait say tiny particles of potentially hazardous material could be causing a host of problems in humans, from respiratory ailments to heart disease to neurological conditions.

After taking samples, scientists found fungi, bacteria and heavy metals — including uranium that could all cause long-term health effects.

"You can see the dust," said Dale Griffin, an environmental public health microbiologist with the U.S. Geologic Survey. "It's what we can't see that will get you."

Three recent reports detail the problems, and Griffin said there

are more to come.

chairs the medical sciences and biotechnology department at the Center for Naval Warfare Studies, part of the Naval War College, coauthored with Griffin a report that they presented last year at the International Seminars on Planetary Emergencies in Italy.

The paper summarized their analysis of sand samples taken in 2004 in Iraq and Kuwait, which revealed a "significant biodiversity of bacterial, fungi and viruses of which 25 percent are known pathogens."

Just as troubling, according to the paper, was the presence of 37 elements - including 15 bioactive metals known to cause serious, long-term health effects in humans, including uranium.

Navy Capt. Mark Lyles, who naturally in the soil in the Middle were up nearly 200 percent.

refineries or factories in industrial areas, Griffin said. He also said the toxins could have been exposed or loosened as U.S. Humvees and tanks churned up the hardened desert top layer that has held dust down for centuries.

In a separate study, Griffin researched dust in Kuwait and around the world, and reviewed other studies, and found that bacteria can be carried by the wind. He said that finding contradicts military researchers during the 1991 Persian Gulf War era who did no microbiological research because they incorrectly concluded the region was too hot for anything to live in the desert sand.

A recent Military Times analysis of military health data from 2001 to 2009 showed the rate of respiratory issues among active-duty troops rose by 32 percent; cardiovascular disease rose 30 percent; pregnancy and birth complications were up 47 percent; and neurological conditions, such as multiple Some of the toxins may occur sclerosis and Parkinson's disease,



Researchers investigating dust in Iraq and Kuwait say they found a combination of fungi, bacteria and heavy metals that could cause long-term health problems.

The National Research Council of the National Academies released a report this year that said the Defense Department's Enhanced Particulate Matter Surveillance Program needs to be reworked, and that the military lacked sufficient data to properly study the health effects of particulate matter exposure.

matter and a broad array of respiratory and cardiovascular effects in the general population and in susceptible people.

The tiniest particles - up to 1,000 of which can sit on the head of a pin - embed deeply in the lungs along with whatever matter they carry. Griffin said he worries that the combination of That report came in the wake of bacteria, fungi and metal found in two other military studies — one — Iraq and Afghanistan can further

### Newsline

THURSDAY, MAY 12, 2011

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APPLIED AND ENVIRONMENTAL MICROBIOLOGY, July 2011, p. 4285–4292 0099-2240/11/\$12.00 doi:10.1128/AEM.00021-11 Copyright © 2011, American Society for Microbiology, All Rights Reserved.

#### Application of a Broad-Range Resequencing Array for Detection of Pathogens in Desert Dust Samples from Kuwait and Iraq<sup>∇</sup>

Tomasz A. Leski, \*\* Anthony P. Malanoski, \*\* Michael J. Gregory, \*\*†
Baochuan Lin, \*\* and David A. Stenger\*\*

Center for Bio/Molecular Science & Engineering, Code 6900, and Chemistry Division, Code 6100,2 Naval Research Laboratory, Washington, DC 20375

Received 5 January 2011/Accepted 26 April 2011

A significant percentage of the human population is exposed to high levels of naturally occurring airborne dusts. Although the link between airborne particulate inhalation and a variety of respiratory diseases has long been established, little is known about the pathogenic role of the microbial component of the dust. In this study, we applied highly multiplexed PCR and a high-density resequencing microarray (RPM-TEI version 1.0) to screen samples of fine topsoil particles and airborne dust collected in 19 locations in Iraq and Kuwait for the presence of a broad range of human pathogens. The results indicated the presence of potential human pathogens, including Mycobacterium, Brucella, Coxiella burnetii, Clostridium perfringens, and Bacillus. The presence of Coxiella burnetii, a highly infectious potential biowarfare agent, was confirmed and detected in additional samples by use of a more sensitive technique (real-time PCR), indicating a high prevalence of this organism in the analyzed samples. The detection of potentially viable pathogens in breathable dusts from arid regions of Iraq and Kuwait underscores the importance of further study of these environments.

#### Debate Swirls Around Research Showing Lung Problems for Returned Troops

As a teenager in northern New York, Gery Durham ran cress-country and hiked the Adirondack's high peaks. In Army basic training, he did two-mile runs in under 13 minutes. But after a yearlong denicyment to Iran with the illst Airborne Division in 2003, he says he started gasping for air while just

An emerging body of research indicates that Mr. Durham is one of a significant number of American service members who are reporting respiratory problems like coughing, wheezing or chest pains that started during deployment and continued after they returned

In 2009, a major survey of military ersonnel, the Millennium Cohort Study, found that 14 percent of troops who had deployed reported new breathing problems, compared with 10 percent

among those who had not deployed. Though the percentage difference seems small, when extrapolated for the two million troops who have deployed since 2001, the survey suggested that at said Capt. Mark Lyles, the chairman of medical sciences and biotechnology at the Center for Naval Warfare Studies in Newport, R.I., who has studied dust from Iraq and Afghanistan.

On the other side of the debate are of ficials with the Pentagon and the Department of Veterans Affairs who assert that current research remains inconclu rive. They acknowledge that some troops are returning with respiratory symptoms but say those problems vary widely depending on genetic background or location of deployment and are usually temporary.

"I think we are going to find that there is some increase in respiratory diagnoses," said Col. Lisa Zacher, a doctor who is the pulmonary consultant to the Anny's surgeon general, "But I think we'll find the majority who deploy do not have long-term chronic pulmo nary diseases related to deployment."

Mr. Durham's breathing struggles have proved to be long-term. When he returned to Fort Campbell, Ky., in 2004, Mr. Durham was coughing up phiegm daily. Running became impossible. Yet a



Gary Durham of Smyrna, Tenn., says he has struggled to breathe since returning from Iraq. His son Larkin, 5, watched him undergoing treatment.

small airways that can make breathing during moderate exercise feel like warking air through a straw," Dr. Miller Fifteen other biopsies led to diag-

Junyone who shows up at our clinics

smoke from a sulfur mine fire near Mo sul, Iraq, in 2008 that may have injured their lungs, suggesting that those injuries are unique to a relatively small group of soldiers. Dr. Miller, however, said that some of his patients were de-

government, Dr. Anthony Szema, was

an author last year of a paper that found

that previously deployed troops were

more likely to report new cases of asth-ma than troops who had not deployed.

In more recent research, Dr. Szema,

an allergy expert at the Stony Brook

School of Medicine and the Northport

Veterans Affairs Medical Center of

Long Island, has found that previously

deployed troops are far more likely than

nondeployed troops to report breathing

noblems that lead doctors to order lung

function tests. He calls the diverse lung

problems he believes exist Iraq-Afghan-

Colonel Zacher and other military of-

ficials have raised sharp questions

about the research by Dr. Miller, Dr.

Miller's patients were exposed to acidic

The officials say that many of Dr.

stan War Lung Injury.

Szema and Captain Lyles.

played after 2003. In a statement, the Navy said that Captain Lyles's work lacked "scientific nt forces take ata airport ps pushed farther

#### Memphis still s, BBQ contest

n reports, 4A

rd level, but "98% of our sm official says. 4B. n home, find ruin, 3A.

#### dbugs: Some tant germs

resistant staph bacteria ver hospital patients; s spread disease. 2A.



ite HP Veer has splay and

### n experts can't explain 'outbreak of insanity'

engers have tried to open cockpit, while in flight. Experts say there's no rorry: Exit, cockpit doors secure. 3A.

#### s pass Filipinos as USA's -largest Asian group

a show Asians grew at same 43% rate s over the past decade. 3A.

#### -trading conviction attle Wall Street

send zero-tolerance message with nst co-founder of Galleon Group. 1B.

#### ug combination helps atic cancer patients



### Could dust be the cause of war vets' ailments?

#### Navy researcher links toxins in particles to a range of illnesses

By Kelly Kennedy USA TODAY

U.S. troops in Iraq, Afghanistan and Kuwait have inhaled microscopic dust particles laden with toxic metals, bacteria and fungi - a toxic stew that may explain everything from the un-

diagnosed Gulf War Syn-COVER drome symptoms lingering from the 1991 war against Iraq to high rates

of respiratory, neurological and heart ailments encountered in the current wars, scientists say.

"From my research and that of oth ers, I really think this may be the smoking gun," says Navy Capt. Mark Lyles, chair of medical sciences and biotechnology at the Center for Naval Warfare Studies at the Naval War College in Newport, R.I. "It fits everything

- symptoms, timing, everything." Lyles and other researchers found that dust particles - up to 1,000 of which can sit on the head of a pin gathered in Iraq and Kuwait contain 37 metals, including aluminum, lead, manganese, strontium and tin. The



Lyles: "This may be



See two war veterans talk about their illnesses and learn more about dust research at usatoday.com

the metals occur naturally and as a byproduct of pollution. Researchers in and out of the mil itary say that the particles are smaller and easier to inhale than most dust particles and that recent droughts in the region have killed desert shrubs that helped keep down that dust. The military's heavy vehicles have pound ed the desert's protective crust into a layer of fine silt, Lyles says, Service-

members breathe the dust - and all it

metals have been linked to neurological disorders, cancer, respiratory ail

ments, depression and heart disease. according to the Environmental Protection Agency. Researchers believe

carries - deeply into their lungs. The dust contains 147 kinds of bac teria, as well as fungi that could spread disease, Lyles found. Since the wars began in Iraq in 2003 and in Afghanistan in 2001, the military has seen a 251% increase in the rate of neurological disorders per 10,000 active-duty servicemembers, a 47% rise in the rate of respiratory ailments and a 34% increase in the rate of cardiovascular disease, according to a USA TODAY analysis of military morbidity

records from 2001 to 2010. Those increases have researchers

Please see COVER STORY next page ▶

speking possible causes.

Despite the research by Lyles and others, and the documented spikes in respiratory illnesses, Defense Department officials contend there are no health issues associated with the dust.

The (Defense Department) has examined the concerns raised by the studies accomplished by Capt. Lyles," says Craig Postlewaite, who heads up the Secretary of Defense's Force Readiness and Health Assurance Office. He said the

military found the dust is "not noticeably different from samples collected in the Sahara Desert and desert regions in the U.S. and China."

Lyles initially analyzed dust samples from Iraq and Kuwait in 2003 to help determine a way to keep the grit from rendering medical equipment

'When I saw the data, I said, 'Oh my God. This can't be right," " Lyles says.

Harry Fannin, a chemistry professor at Murray

"It was a little bit unusual," he says, citing high levels of chromium, nickel and other metals,

"You wouldn't see metal like that in the U.S.," he says, adding he was most concerned about the tiny size of the particles, "Any time you have respirable particles, it's bad." Scientists know fine particulate matter - that

smaller than 10 micrometers, or about one-fourth the size of a single grain of table salt - can cause lung and respiratory problems, Catherine Cahill, associate professor at the Geophysical Institute at the University of Alaska, be-

gan collecting airborne dust for the military with the Army Research Lab in Baghdad in 2008. 'Tve done sampling since 1986, and I've never seen anything that bad - not even in China," she says, referring to China's extreme levels of pollu-

tion. The everyday fine particulate matter levels in Iraq were about three times greater than what the EPA says is healthy within a 24-hour period, she says - and those levels should not be exceeded more than once per year. "We're blowing that standard out of the water."

She called the abundance of aluminum and lead she found "our worst-case scenarios." Cahill says her research mirrors the work done by Lyles.

"Most things are high is the bottom line," she says, 'I would expect chronic coughs, asthma respiratory disease in the short term; and (chronic obstructive pulmonary disease), heart problems and hypertension long-term. Mark's theory, to me, makes perfect sense.

Lyles' team found almost 150 kinds of bacteria 25% of which may cause diseases such as menin gitis, cystic fibrosis, septic arthritis, gastroenteri tis, staph infections, diarrhea and food poisoning.

#### Defense Department: Not so fast

The Defense Department says it hasn't linker any illnesses among servicemembers to bacteri in the soil.

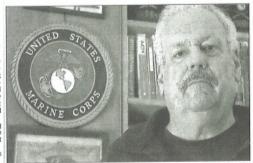
"All soil, no matter where it is found, has germ present, so this finding is not unusual," Postle waite says, "We have closely examined our med ical surveillance data for those personnel wh have deployed - some multiple times - and w have not been able to identify any increase disease that could be associated with the germ that were identified in the soil."

But Lyles found others who saw anomalies.

Bob Miller, a pulmonologist at Vanderbilt Un versity Medical Center, worked with 101st Air borne soldiers at Fort Campbell, Ky., after the complained of being short of breath and unable t run as fast as they had before they deployed.

Many had been exposed to a sulfur fire Mosul, Iraq. They also had been exposed to but pits - the military disposes of trash at bases Iraq and Afghanistan by burning as much as 24 tons of it a day in open pits. All of them can through chest X-rays and CT scans with clean bil of health. The soldiers volunteered for a proc dure to obtain lung cell samples, and when Mill examined the biopsies, 50 of 54 showed constri tive bronchiolitis — a rare lung disease that clos the timiest airways.

Those biopsies also turned up dust. "A polarizing lens shows sparkling - that's ti



State University, analyzed the dust for Lyles in late Victim of a rare flu: Richard Stumbo, 63, was airlifted out of Iraq in 2003 after he came down with a severe case of bronchial pneumonia. Doctors believe it was caused by dust he was exposed to in Iraq.

25, and 98% were younger than 55.

definitely interested in Lyles' work."

And early heavy-metal poison

also look the same as post-traum

order (PTSD), he says. "It's all sp

says. "But it's very intriguing, es

there are such high levels of PTSD."

worked as a mechanic in Baghdad

he was still in theater, his hands be

if he were nervous. Now the shakir

his arms, into his legs and sometin

He takes medication to prevent th

interfering with his daily life. His

numb or tingly, his back hurts and

toms," but nobody knows what

"Everything new that comes out -

depleted uranium - I think, 'Mayb

deployed and must use an inhaler.

Capt. J.A. "Cappy" Surrette, spo Navy Bureau of Medicine and Sur

researchers investigated to see w

in Iraq and Afghanistan is toxic. T

record of troops complaining of co

ries unrelated to traumatic brain in

However, he says the Naval I

"There is no definitive basis to

harmful to people or animals," be

However one Navy study is

texticity of sand from Afghanista

affects cell death, he says, A seco

whether Afghanistan dust contr

Navy Petty Officer 2nd Class R

40, of West Fargo, N.D., deploye

Iraq, in 2006, and guarded the p

in an incident that would have car

"My doctors were surprised

from my unit went through the sa

microbiologist with the U.S. Go

also found metals and bacteria in

says. "I believe there is a risk then

'It's a very complex problem'

"We know that certain metal

Dale Griffin, an environment

trauma pathology in animals.

laboratory found that trace met

showed levels of toxicity.

Bowman also has troubles bre-

"It all falls under 'neurological si

feel weak.

Former Army specialist Jeremy

#### What Lyles' research team found

Sand is made up of pure silica, but deserts also include minerals that have been descotted by leng-mare bless; ground water, wind and pollution. Maxy Copt, Mark Lyda Tocacch team found 27 elements in samples of dust from lean and Kuwati, including 15 blocative meshali ball are known to cause or have been linked to serious health effects with where and the linked of the silical serious health effects with where and the linked water and the linked g-term exposure, according to the Environmental nection Agency.

Lyles' team measured settled dust, which service-embers breathe when it rises into the air during a dust storm. Though the government has standards for air pollution that can contain the following elements, there are no standards for exposures to toole elements in settled dust. The metals layles earn frund include:

ream found increos;

> Administratory (7,521 parts permillion), which causes respiratory infections and hug disease, and has been linked to Alzheimer's, multiple sclerosis and other neurological diseases.

nd other neurological diseases.

A Assenic (10 ppm), which can cause lung cancer nd skin and muceus membrane irritation.

Burtum (463 ppm), which can cause breathing moblems, heart pulpitations, muscle weathness, and cart and liver dismage.

➤ Chromium (52 ppm) causes lung cancer and espiratory aliments. Animal tests have shown ent chromium to be extremely toxic when

inhield at arg level.

\*\*Cobalt\*\* (Oppin) can lead to asthma, primorany lisene and previnceia.

\*\*Lead\*\* (188 poin) can lead to headaches, nuiseo, mosele weathers and fatigue.

\*\*Managament 325 poin) has been linited to metabolic touce, principal was been linited to metabolic touce, forfermore disease and browdista.

\*\*Policial\*\* (50 app) can lead to large cancer.

\*\*Policial\*\* (50 app) can lead to large cancer.

\*\*End (5 app) can lead to large cancer.

\*\*\*Silva (5 app) can lead to large cancer.

problems, depression, liver damage, immune systems and chromosomal disorders, a shortage of red blood rells, and beain damage that can lead to anger. sleeping disorders, forgetfulness and headaches according to the Centers for Disease Control and

revention.

> Varsadium (49 ppm) can cause lung and eye

> Zinc (206 ppm) can cause aremia and nervous-

Sources: Mark Lyles, Naval War College; Environmental Protection Agency; Occupational Safety and Health Administration

dust." Miller says. "It is a concern."

He plans to analyze that dust, as well as a brown pigment mixed with it.

"(Lyles) has pretty convincing evidence that the Iraq, in 2008. He began losing we dust is a carrier of toxins," Miller says. "But we respiratory problems and migrain need more information before we can make any with short-term memory loss but sweeping generalizations."

brain injury. In June 2010, he had Veterans Affairs researcher Anthony Szema found that about 7% of veterans who had dehealthy, active adult," he says. "T ployed to Iraq from 2004 to 2007 had asthma, compared with about 4% who did not deploy. Then he heard about the burn pits, as well as Lyles'

"Lyles gave a lecture in Denver," Szema says. "Everyone's jaw was falling on the floor."

The range of respiratory disease he saw didn't appear to be caused by one problem. And it seems to be getting worse: About 11% of soldiers return-

Early in the 2003 Iraq War, a r. ing from Iraq have respiratory problems, he says. Ronnie Homer, chairman of the Department of philic pneumonia - infected 18 Public Health Sciences at the University of Cincin-servicemembers in Iraq, accordi study. Researchers theorized that the bacteria entered troops' lungs through the dust or through bacteria picked up from the ground from tobacco in foreign cigarettes

In 2003, Richard Stumbo worked as a civilian contractor for the Department of the Army when he became sick with a flu so bad he had to be airlifted out of Iraq.

'My doctor said he thought it was some kind of bacteria in the dust that I picked up," Stumbo says. "My boss called me after I got home and told me a couple of the guys had died."

It took Stumbo two months to recover,

Geoff Plumlee, a research geochemist with the U.S. Geological Survey, sifted through dust samples in the aftermath of the World Trade Center attacks in 2001 to determine what in that particulate matter might affect first responders, His work led to legislation meant to take care of people with respiratory problems and cancers who had breathed in the dust.

After looking at Lyles' work, as well as militarysponsored and EPA research, Plumlee said he wants to see more.

"It's a very complex problem," he says. "I think all of the different studies are pointing to a need nati. saw clusters of servicemembers with ALS - for a very detailed look."

Richard Meehan, chief of rheumatology at Naor Lou Gehrig's disease - after the 1991 war in tional Jewish Health in Denver, assisted the ALS affects about 1 to 2 people per 100,000 — Army's Public Health Command with a particulate usually men older than 55. Half the Desert Storm matter study. veterans diagnosed with ALS were younger than

National Jewish had received several cases similar to those of Miller's at Vanderbilt, and Meehan "We know that aluminum has been associated began to think it might be more than simply the with ALS, as well as lead," Horner says. "We were burn pits. "We wanted to know why we were seeing these rare injuries that Bob Miller was

USA TODAY WEDNESDAY, JULY 6, 2011

## Background

WASHINGTON

## Scientists: Pentagon misleads on dust-risk study

#### Say data of health effects to troops in war zones don't support claims

By Kelly Kennedy USA TODAY

WASHINGTON - The Pentagon is falsely claiming its research shows that airborne dust in Iraq and Afghanistan poses no health risk to U.S. troops, say three scientists whose review of that research found it riddled with mistakes.

Military officials then falsely said the review of their research backed their conclusion that the dust in the two war zones is no different from that in California. scientists Philip Hopke, Mark Utell and Anthony Wexler say.

The scientists, who issued their report last year for the National Research Council (NRC) of the National Academy of Sciences, were part of a team that request of the Pentagon.

The earlier report, which was conducted for the military by the Nevada-based Desert Reincorrect conclusions and used 2010. faulty research methods, the

2010 study showed.

It is simply not true that research supports the Pentagon's claim that Middle Eastern dust is similar to that in the United States or that it poses no health risks, says Hopke, a Clarkson University scientist who conducted the National Research Council study.

"It's a bit disappointing when they know that, realistically, the data does not support that conclusion," he says.

Both studies were conducted to better understand risks as the number of U.S. troops who served in Iraq and Afghanistan and developed mysterious and severe respiratory conditions skyrocketed after their service. Since the start of the wars in 2003 and 2001, neurological reviewed a 2008 study at the disorders per 10,000 active-duty servicemembers have risen by 251%, while respiratory issues jumped by 47%, according to a Pentagon Force Protection and USA TODAY analysis of military search Institute, made a series of morbidity records from 2001 to



Thick cover: Marines deal with dust kicked up by a Black Hawk helicopter in May as they rush a colleague wounded from an improvised explosive device in Afghanistan's volatile Helmand province.

written memos in recent months. Pentagon health officials have claimed that the 2008 study found nothing wrong with the dust from the Middle East, "It is not noticeably different from samples collected in the Sahara Desert and desert regions in the U.S. and China," Craig Postlewaite, head of the Readiness Office, told USA TO-DAY for a May story.

In a series of interviews and tlewaite and other Pentagon of- wrote.

ficials later said, "attempts to form a 'cause and effect' relationship' but there is "no evidence on which to base such a tional Research Council study. relationship."

In a blog on the Defense Department's website, Navy Capt. Patrick laraby cited the NRC study directly: "After an exhaustive review, the NRC was unable to identify any health risks and indicated that they would need more data to determine wheth-That USA TODAY report, Pos- er there were any risks," Laraby

Utell, a professor at the University of Rochester School of Medicine who headed the Nasays it's incorrect for the Pentagon to claim the council's research found "no adverse health

Instead, he says, the 2010 study found there could be nezative health effects from the dust and that the 2008 research was so flawed "that they wouldn't be able to determine that with their study."

vis. say their study found that the military's research in the 2008 report was flawed from the beginning, and the council made no statement that the dust is safe or similar to that back home. In fact, they say the Army's research was so "ill-founded"

Utell, Hopke and Wexler, of

the University of California-Da-

that it couldn't be used to determine anything other than that the fine particulate matter levels in the Middle East far exceeded recommended World Health Organization levels.

Postlewaite did not respond directly to questions about how he and others represented the two studies. Instead, he said the council praises the military's "ability to carry out such a largescale exposure-monitoring study in the midst of a military

Johann Engelbrecht, the Desert Research Institute scientist who led the 2008 study, calls the council report "probably a fair judgment" and says he plans to use its recommendations for his upcoming report.

DRI, Engelbrecht says, is independent and was not pressured by the military.



http://www.sciencenews.org/view/generic/id/72020

Home / News / April 23rd, 2011; Vol.179 #9 / Article

Just breathing in Iraq can be hazardous

Poor air quality an added danger to troops

By Rachel Ehrenberg
April 23rd, 2011; Vol.179 #9 (p. 15)



ENLARGE

The dirt behind the dust

Published Date: July 10, 2009 By Shaheen Al-Haddad, Staff writer, Kuwait Times

iii

Dust storms like this one in Baghdad can expose troops to unsafe levels of dust and other particles, air-quality monitoring indicates.

## **NavyTimes**

http://www.navytimes.com/news/2010/07/navy\_toxic\_dust\_071210w/

## Study finds toxic metals in dust in Afghanistan

By Andrew Tilghman - Staff writer

Posted : Monday Jul 12, 2010 7:41:46 EDT

Here's another thing to worry about when you deploy: toxic dust.

A new Navy study suggests that dust from Afghanistan contains metals that may cause respiratory problems and brain damage.

"Afghanistan sand produces neurotoxicity ... with potential adverse health effects to our soldiers," according to a briefing of the study presented at a medical conference in June in Portland, Ore.

The Navy conducted the study in response to anecdotal concerns that the dust and dust storms common in the Middle East may be harmful. The dust samples were taken from Forward Operating Base Salerno near Khost, which was selected because of its relative isolation with no nearby industry that could skew results.

#### THE WALL STREET JOURNAL.

WSJ.com

HEALTH INDUSTRY | MAY 17, 201

#### Troops in Mideast Face Breathing Ills

Burn Pits a Possible Factor as Data Show Higher Rate of Respiratory Woes Among Veterans of Afghanistan, Iraq
By SHIRLEY S. WANG

Veterans who served in Iraq and Afghanistan have a higher rate of debilitating respiratory illness than those deployed elsewhere, according to a new study that bolsters concerns among some medical professionals and members of Congress about the potential harm to troops from toxic chemicals and dust in the Middle East.

Not H

The findings, which will be presented Wednesday at the
International Conference of the American Thoracic Society in
Denver, place renewed urgency on getting at the root of why some
young, previously healthy soldiers have been returning from the
Middle East complaining of symptoms including shortness of
breath and dizziness. In many cases, the soldiers can no longer

#### Not Even Breathing Is Safe in Iraq

By Rachel Ehrenberg, Science News March 31, 2011 | 3:52 pm | Categories: Health



oldiers who served in Irag or Afghanista

gering coughs, shortness of breath, diz her symptoms. Now, scientists say troo rved in the Middle East have higher rat

spiratory problems compared to those v sewhere. WSJ's Shirley Wang reports.

Agence France-Presse

U.S. soldier from observes an Afghan in hole to be used as a garbage dump at abloghay Camp in Zari district of Kanda wince



ANAHEIM, California — As if enemy fire, IEDs and suicide bombers weren't enough, U.S. soldiers in Iraq also must contend with air that's laden with heavy metals and lung-ravaging particles, researchers reported March 30 at the spring meeting of the American Chemical Society. Exposure to particles of the size collected in the study is of special concern, because it can lead to chronic respiratory infections, asthma and elevated risk of cardiovascular problems.

#### ORIGINAL ARTICLE

#### Constrictive Bronchiolitis in Soldiers Returning from Iraq and Afghanistan

Matthew S. King, M.D., Rosana Eisenberg, M.D., John H. Newman, M.D., James J. Tolle, M.D., Frank E. Harrell, Jr., Ph.D., Hui Nian, Ph.D., Mathew Ninan, M.D., Eric S. Lambright, M.D., James R. Sheller, M.D., Joyce E. Johnson, M.D., and Robert F. Miller, M.D.

#### ABSTRACT

#### RACKGROUN

In this descriptive case series, 80 soldiers from Fort Campbell, Kentucky, with inhalational exposures during service in Iraq and Afghanistan were evaluated for dyspnea on exertion that prevented them from meeting the U.S. Army's standards for physical fitness.

#### METHODS

The soldiers underwent extensive evaluation of their medical and exposure history, physical examination, pulmonary-function testing, and high-resolution computed tomography (CT). A total of 49 soldiers underwent thoracoscopic lung biopsy after noninvasive evaluation did not provide an explanation for their symptoms. Data on cardiopulmonary-exercise and pulmonary-function testing were compared with data obtained from historical military control subjects.

#### RESULTS

Among the soldiers who were referred for evaluation, a history of inhalational exposure to a 2003 sulfur-mine fire in Iraq was common but not universal. Of the 49 soldiers who underwent lung biopsy, all biopsy samples were abnormal, with 38 soldiers having changes that were diagnostic of constrictive bronchiolitis. In the remaining 11 soldiers, diagnoses other than constrictive bronchiolitis that could explain the presenting dyspnea were established. All soldiers with constrictive bronchiolitis had normal results on chest radiography, but about one quarter were found to have mosaic air trapping or centrilobular nodules on chest CT. The results of pulmonary-function and cardiopulmonary-exercise testing were generally within normal population limits but were inferior to those of the military control subjects.

#### CONCLUSIONS

In 49 previously healthy soldiers with unexplained exertional dyspnea and diminished exercise tolerance after deployment, an analysis of biopsy samples showed diffuse constrictive bronchiolitis, which was possibly associated with inhalational exposure, in 38 soldiers.

## New-onset asthma among soldiers serving in Iraq and Afghanistan

Anthony M. Szema, M.D.,<sup>1,2</sup> Michael C. Peters, M.D.,<sup>1,2</sup> Kristen M. Weissinger, B.A.,<sup>3</sup> Christy A. Gagliano, M.S.,<sup>1</sup> and John J. Chen, Ph.D.<sup>2</sup>

#### ABSTRACT

Since June 4, 2004, asthma diagnosed and symptomatic after the age of 12 years has been an exclusion criterion for military



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#### **Original Contribution**

Newly Reported Respiratory Symptoms and Conditions Among Military Personnel Deployed to Iraq and Afghanistan: A Prospective Population-based Study

Besa Smith\*, Charlene A. Wong, Tyler C. Smith, Edward J. Boyko, Gary D. Gackstetter, and Margaret A. K. Ryan for the Millennium Cohort Study Team

\* Correspondence to Dr. Besa Smith, Department of Defense Center for Deployment Health Research, Naval Health Research Center, 140 Sylvester Road, San Diego, CA 92106-3521 (e-mail: besa.smith@med.navy.mil).

Initially submitted November 26, 2008; accepted for publication August 12, 2009.

Concerns about respiratory conditions have surfaced among persons deployed to Iraq and Afghanistan. Data on 46,077 Millennium Cohort Study participants who completed baseline (July 2001–June 2003) and follow-up (June 2004–February 2006) questionnaires were used to investigate 1) respiratory symptoms (persistent or recurring cough or shortness of breath), 2) chronic bronchitis or emphysema, and 3) asthma. Deployers had a higher rate of newly reported respiratory symptoms than nondeployers (14% vs. 10%), while similar rates of chronic bronchitis or emphysema (1% vs. 1%) and asthma (1% vs. 1%) were observed. Deployment was associated with respiratory symptoms in both Army (adjusted odds ratio = 1.73, 95% confidence interval: 1.57, 1.91) and Marine Corps (adjusted odds ratio = 1.49, 95% confidence interval: 1.06, 2.08) personnel, independently of smoking status. Deployment length was linearly associated with increased symptom reporting in Army personnel (P < 0.0001). Among deployers, elevated odds of symptoms were associated with land-based deployment, inconsistency in risk with cumulative exposure time suggests that specific exposures rather than deployment in general are determinants of postdeployment respiratory illness. Significant associations seen with land-based deployment also imply that exposures related to ground combat may be important.

longitudinal studies; lung diseases; military personnel; signs and symptoms, respiratory

#### Original Paper

European Neurology

Eur Neurol 2005;53:125-131 DOI: 10.1159/000085556 Received: August 17, 2004 Accepted: February 10, 2005 Published online: April 28, 2005

#### Experimental Lung Research 29:29–14, 2003 0190-2148/03 \$12.00 + .00 DOI: 10.1080/01902140390116535



#### Epidemiology of Multiple Sclerosis in Kuwait: New Trends in Incidence and Prevalence

A.F. Alshubaili K. Alramzy Y.M. Ayyad Y. Gerish

Department of Neurology, Ibn Sina Hospital, Safat, Kuwalt

#### **Key Words**

Gulf War · Kuwait · Multiple sclerosis · Arab countries

#### Abstract

The epidemiology of multiple sclerosis (MS) is undergoing dramatic changes; MS is occurring with increased frequency in many parts of the world. In this retrospective study, we examined the changes in incidence and prevalence of MS in Kuwait in the period between 1993 and 2000. We analyzed the records of patients with clinically defined and laboratory supported MS. The total incidence rate increased from 1.05/100,000 population in 1993 to 2.62/100,000 in 2000. The increased incidence of MS was most pronounced among Kuwaiti women (from 2.26/100.000 in 1993 to 7.79/100.000 in 2000. The total prevalence rate increased from 6.68/100,000 in 1993 to 14.77/100,000 in 2000. It was much higher for Kuwaitis (31.15/100,000), as compared to non-Kuwaitis (5.55/ 100,000), in a complete reversal of the pattern observed before 1990. The prevalence was also higher among Kuwaiti women (35.54/100,000), as compared with Kuwaiti men (26.65/100,000). In conclusion, the incidence and prevalence of MS in Kuwait has increased between the early and late 1990s with no signs of leveling off. In a geographic area that was previously associated with low prevalence, local environmental factors may be responsible for these dramatic changes.

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#### Introduction

Multiple sclerosis (MS) affects millions of people worldwide and it is particularly common among Caucasians of northern European descent. To various extents, other races and ethnic populations are thought to be less susceptible to MS. For example, MS is virtually unknown in black Africans and it is generally rare in tropical areas. The prevalence of MS increases proportionally with the distance from the equator, excluding the polar regions. Although these geographic differences in the prevalence of MS are usually interpreted as being due to environmental factors, the prevalence gradient may also be partially related to genetic susceptibility [1].

Prior to the first Gulf War in 1990, the two major population groups in Kuwait were Kuwaitis and Palestinians. A significantly higher prevalence of MS was observed in Palestinians (23.8/100,000 population) than in Kuwaitis (9.5/100,000) [2]. The make-up of the population has changed dramatically since the war, especially with respect to relative proportion of non-Kuwaitis. For sociopolitical reasons, the Palestinians no longer represent the major expatriate group in Kuwait; they have been replaced by a less homogeneous population, with a major Asian ethnic minority from the Indian subcontinent and other Arab countries, such as Egypt and Syria. After the Gulf War, a marked increase in MS was reported, particularly among Kuwaitis. In this study, we have examined this trend, to determine whether there are indeed increases in the incidence and prevalence of MS in Kuwait.

### RESPONSE OF HUMAN ALVEOLAR MACROPHAGES TO ULTRAFINE, FINE, AND COARSE URBAN AIR POLLUTION PARTICLES

Susanne Becker and Joleen M. Soukup		United S	States Enviro	nmental I	Protection
Agency, National Health and Environmental E Park, North Carolina, USA	Effects	Reserach	Laboratory,	Research	Triangle

Constantinos Sioutas		Department o	f Civil	Engineering,	University of Southe	ern
California, Los Angeles, Co	liforni	ia, USA				

Flemming R. Cassee		Laboratory	of Health	Effects	Research,	National	Institute of
Public Health and Enviro	nmen	t, Bilthoven	. The Net	herlana	ls		

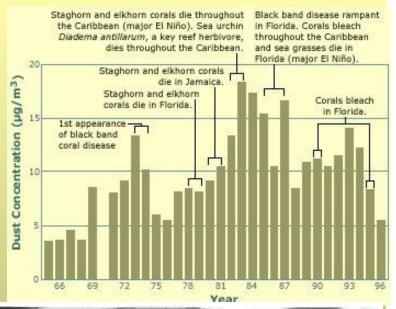
B 0 4 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
☐ In the lower airways, macrophages are important regulators of inflammation and indispense
ble in their antimicrobial activities. Thus, air pollution particles, which modulate airway macro
phage host defenses may, in susceptible individuals, increase severity of inflammatory an
infectious disease. In the present study, size fractionated, ultrafine (UF), fine (PM0.1-2.5), an
coarse (PM23-10) particulate matter (PM) were collected from 2 urban sites in the Netherlands
and were compared for effects on human alveolar macrophages (AM). Inflammatory cytokine pro
duction, phagocytosis, and expression of phagocyte receptor CD11b were assessed in particle-expose
AM. Interleukin (IL)-6 levels induced by PM <sub>2.5-10</sub> (20411 pg/mL) were > 10-fold higher than in
duced by PM <sub>0,1-2.5</sub> (1781 pg/mL). Levels induced by PM <sub>0,1-2.5</sub> were 2- to 3-fold higher than in
duced by UF (770 pg/mL) when cells were exposed to the same particle mass. Cytokine induction by
the PM was inhibited by antibody to CD14 and required the presence of serum for optimal stimule
tion, implying that bacterial products or endotoxin were stimulatory moieties in both coarse and fin
And the state of t
particulate matter, Phagocytosis of obsonized yearst was inhibited by coarse more than by fine PM, a

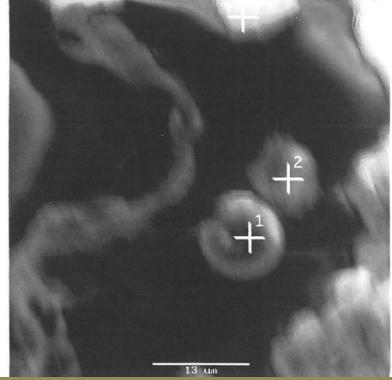
Received 9 April 2002; accepted 17 June 2002.

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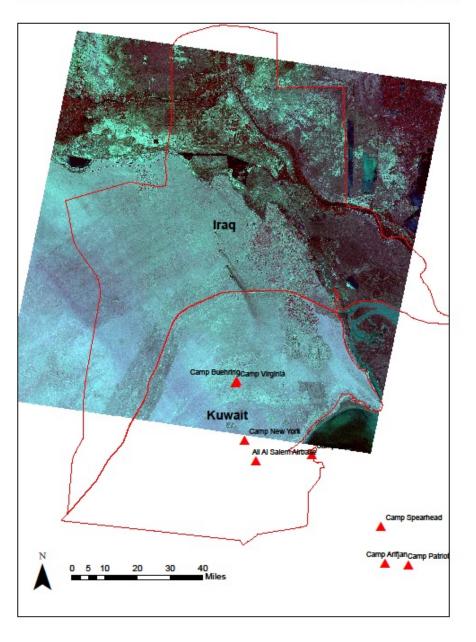
Disclaimer: The research described in this article has been supported by the United States Environmental Protection Agency. It has been subjected to Agency review and has been approved for publication. Approval does not necessarily reflect the views of the Agency and no official endorsement should be inferred. Mention of trade names and commercial products does not constitute endorsement or recommendation for use.

The authors thank Mingchih Chang and Paul Fokkens for collecting the particles and maintaining the PM collection instrumentation, and the staff of the Medical Station at EPA Human Studies Division in Chapel Hill, NG, for providing alveolar macrophages for these studies. The helpful suggestions of Dr. Ian Gilmour and Dr. David Peden in preparation of this manuscript are much appreciated.





Iraq-Kuwait Border January 30th 2003 Landsat7 ETM+ Pan-sharpened Infrared False Color Composite (RGB432)



## **Potential Pathophysiologies**

### \* Chemical

- Respiratory distress
- Immune suppression
- Systemic neuropathies
- Other 'toxic' symptoms

### \* Biological

- \*Respiratory distress and acute inflammation
- Immune suppression with systemic bacteremia
- \*Acute and chronic systemic effects including neurologies, cardiovascular events, autoimmune pathologies, etc.



